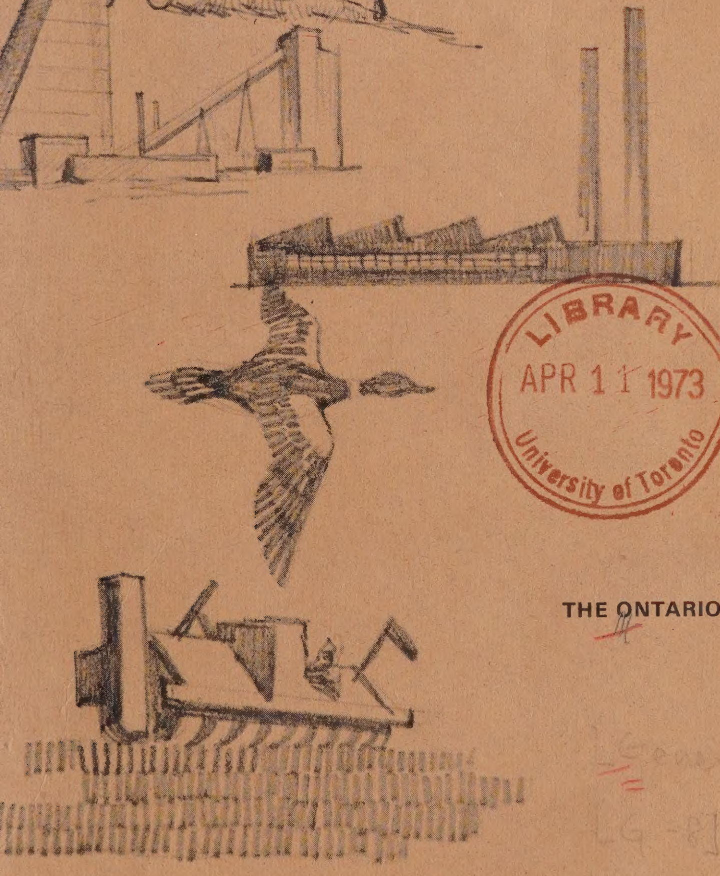
DEVELOPING A BETTER ENVIRONMENT



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DEVELOPING A BETTER ENVIRONMENT

Ecological Land-Use Planning in Ontario

A Study of Methodology in the Development of Regional Plans

by

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for

the Graduate Department of Forestry
University of Toronto

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(George) Angus Hills

Angus Hills, the principal author of this publication, has had long experience in the study of soils and in the testing of his findings in relation to agriculture and forestry. This experience has served as excellent background for his more recent interest in the classification and evaluation of land for biological production. This in turn has provided the foundation on which he has developed a system of land classification including related concepts, principles and methods which facilitates planning for the use of natural resources at all levels from the management unit to the planning region. These concepts are discussed in detail in this publication.

Mr. Hills obtained his B.S.A. degree in 1937 from the Ontario Agricultural College at Guelph and his M.S.A. degree in soil chemistry in 1942 from the University of Toronto and the Ontario Agricultural College. From 1937 to 1944 he was employed as Senior Soil Scientist at the Ontario Agricultural College. In 1944 he joined the Ontario Department of Lands and Forests as Soil Research Specialist and was Chief Research Scientist in charge of Site Research from 1954 until his retirement in 1967. Since 1967 he has been on the staff of the Faculty of Forestry, University of Toronto.

In addition to his academic achievements Mr. Hills has been active in the preparation of plans related to the Ontario development of regional governments.

FOREWORD

The population of southern Ontario continues to grow.

The land area of this part of the province, however, is fixed.

Pressures on land use will mount.

Proper care and imagination in planning is, therefore, a key to Ontario's future, both as a prospering economy and as an area in which it is pleasant to live, to work and to play.

The same piece of land, fortunately, may often serve more than one purpose. Cooperation between the private and public sectors can not only ensure the production of needed agricultural products and timber but simultaneously serve the demand for open space recreation and the protection of our ecological heritage.

How may this multi-purpose land use best be accomplished?

One answer is provided in this publication.

The Ontario Economic Council commissioned its preparation primarily because it introduces a new inter-disciplinary planning process not yet too well known or practiced but one which has a potentially broad application.

This book, which is to serve as a text in at least one major Ontario university graduate studies program, should also be read in association with the Council papers published this year on "Trends, Issues and Possibilities for Urban Development in southwestern and central Ontario" and our 1966 report, "People and Land in Transition." Each, it is hoped, will serve to throw some additional light on the link between our human and natural environment and the social and economic patterns affected.

The Ontario Economic Council expresses its appreciation to the senior author, G. Angus Hills, who developed the methodology described herein largely over the past decade and to professors David Love and Douglas Lacate whose cooperation and leadership made possible this publication.

William H. Cranston
Chairman.

October 1970.

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Chapter 1

INTRODUCTION

1.0 DEVELOPMENT OF THE ECOLOGICAL LAND-USE PLANNING COURSE

A graduate course in this subject was conducted under the aegis of the Graduate Department of Forestry, University of Toronto, in the summers of 1968 and 1969; the course director for both years was G. A. Hills, and in 1969 he was supported by D. V. Love and D. S. Lacate. The course headquarters for both years was at Wasaga Beach, Simcoe County, in accommodation provided by the Ontario Department of Lands and Forests. In 1969 financial assistance was made available through the Ontario Economic Council for whom this publication has been prepared.

Although the summer course has been discontinued, a modified version of this course will be offered by G. A. Hills at the Faculty of Forestry, University of Toronto. It will involve seven weeks of field work and a lecture and seminar course conducted throughout the session.

This publication covers the lecture material presented during the summer course. Complementing the lecture material was an intensive field course in soils and in land classification and land evaluation. In addition, specialists in a wide range of land uses and in land-use planning led discussions on pertinent topics. A list of the names of those who contributed to the course is shown below along with the names of the students who attended the course.

The course is not designed to produce experts in either land classification or regional planning; it is a field and lecture course in the assessment of basic land units classified in terms of their natural characteristics and in the recognition of social and economic pressures which must be considered in rating land for its use in serving human needs. In the pursuit of these objectives of the course the students, acting as a group, prepared a "scenario" of the Simcoe Region which represents a broad plan of recommended uses for the area in the year 2000. The scenarios prepared by the students in 1968 and in 1969 are included in Chapter 7 of this publication.

1.1 THE NATURE OF ECOLOGICAL INTERPRETATION FOR LAND MANAGEMENT AND LAND-USE PLANNING

Although planning for effective land use requires an inventory of the land, the inventory alone does not provide the necessary background for planning. A knowledge of ecosystems is also required and this is gained through pursuing the following steps.

(a) Identify sites which are homogenous with respect to their physiography, i.e., physiographic site type, and determine their capability to supply materials and energy for various types of biotic production. Levels of capability can only be stated in terms of specific types of crops and methods of management.

(b) Identify benchmark types of crop communities (biotic site types) which develop on each physiographic site type.

(c) A benchmark physiographic site type and a benchmark biotic site type in combination constitute a benchmark site.

The steps required in getting to know human ecosystems are much more complex. These involve not only the study of relationships *within* homogenous biotic ecosystems but also relationships *between* these units. The occupancy of patterns of biotic ecosystems by human communities introduces this complexity. Thus the analysis of ecosystems is an educational experience which demands both highly technical skills and a highly developed interpretive ability.

1.2 THE COURSE OBJECTIVE

In planning this course an attempt was made to develop one which would provide single-discipline practitioners with that educational experience which would introduce them to other disciplines and qualify them as members of a planning team.

"Why practitioners and not theorists in ecology, geography (human ecology) and land-use planning?" you may ask. Who are as well qualified to indicate what will be the response of specific areas of land to meet the demands of the people for specific types of goods and services in the future as those who know where these goods and services are produced now, as well as the levels of production and the attendant intensities of management? Who are so well qualified to develop the recreational potential of land and to create a demand for recreational experiences as those who are now matching qualities of the landscape with the recreational needs of the people?

All production comes from ecosystems, and the relationships between (a) the non-living features of the land, (b) man, and (c) the crops and services which are produced on the land must be assessed in ecological terms if optimum use is to be attained. This assessment is attained by:

(a) identifying and describing on an ecological basis blocks of land;

(b) evaluating these blocks for various uses; and

(c) determining their socio-economic value in an integrated regional plan.

Preferably these studies should be carried out by a team of agronomists, foresters, wildlife biologists, watershed managers, land-oriented geographers, engineers, economists, landscape architects and others.

Since most of the present land managers are technologically oriented in a discrete discipline rather than ecologically trained and conditioned in their work, students taking the course usually require additional background knowledge respecting (a) ecological production units, and (b) land planning methods and principles. With the lack of ecological knowledge on the part of the planner, land-use plans are mere hypotheses. They are postulations which lack the degree of substantiation which the ecological framework provides. With the lack of knowledge of land-use planning principles, the worker finds

it difficult to understand the extent to which the ecological knowledge may be employed in land-use planning. Accordingly, the objective of the course is to provide some insight into ecology and at the same time introduce the fundamental principles of land-use planning.

1.3 DEVELOPMENT OF SCENARIOS

Using a broad brush, the students in each session of the Ecological Land-Use Planning course indicated on a map of the Simcoe Region the kind of land use which they, as citizens of that region, would consider to be the best harmonic development both intra-regionally and inter-regionally (primarily within the Province of Ontario). In order to present such a generalized picture it was necessary to use patterns of land use, the components of which were defined and grouped according to goals set in the context of management and regulation (not necessarily the present one). It was within this framework that the landscape features were observed, classified and evaluated. It was also within this context that homogenous areas were grouped into land units of convenience for an evaluation of their potential to satisfy human needs.

In the development of the students' scenarios the procedures adopted were as follows:

The students were divided into groups of two or three with each group being given a particular discipline (e.g., agriculture, timber production, etc.) to work with. Scenarios were developed as follows:

(a) A reference area of about 2000 acres for each team was laid out covering portions of one or several land units.

(b) Two "areas of concentration", approximating 160 acres each, were set up within the reference area in such a way as to represent the various physiographic sites present.

(c) A detailed analysis of the various physiographic site types in the 160-acre blocks was made with the aid of soil-pit analysis, soil maps and aerial photos.

(d) The physiographic site types were mapped within the detailed blocks and this information was then extrapolated into the remainder of the reference area with the aid of photos, soil maps and supplementary soil pits. This reference area served as a benchmark for classifying other land units.

(e) Use-capability and use-suitability ratings, as discussed in Chapter 6, were then applied to the reference areas and extrapolated to surrounding land units.

(f) Recommended land uses involving both single and integrated uses were then prepared for various landscape units. This involved an integration of information derived from the reference blocks and extensive field and air-photo examination of the major landscapes assessed within the anticipated socio-economic structure.

1.4 LECTURERS AND DISCUSSION LEADERS OF THE COURSE IN 1968 AND/OR 1969

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1.6 ACKNOWLEDGEMENTS

In addition to the direct contribution of the lecturers and seminar leaders named above, many specialists attended the final exercises of the course and contributed through comments and discussion. The authors acknowledge with gratitude the generosity of all those who so freely contributed to the summer course and thus indirectly to the content of this publication.

For assistance in the organization and financial support of the course, thanks must be expressed to officials of the Ontario Department of Lands and Forests and the Ontario Economic Council; without their encouragement and assistance the summer course could not have been developed and this publication could not have been produced.

Finally, the authors wish to recognize the very considerable contribution of the staff of the Faculty of Forestry, University of Toronto, for the preparation for publication of the text, maps and diagrams contained herein.

G. A. H.

D. V. L.

D. S. L.

Chapter 2

ECOLOGICAL LAND USE PLANNING

2.0 LAND-USE ECOLOGY

2.01 The Ecology of a Region

The development of any region, whether it be economic, social or cultural, is dependent upon the totality of the natural and human resources of that region. Its productivity is dependent *not* upon the capabilities of the soil and climate *alone* nor upon the capabilities of the living organisms *alone* but upon specific relationships between living organisms and their *total* environment. Included in these relationships are the inputs of energy, time, money and inspirations of the human resources, weighed against outputs in terms of both physical and societal production. The relationships between input and output are significant for regional analysis only as they are reviewed within the totality of the specific production systems. This totality of pattern of the relationships between the organisms of a region and their environment, which determine its productivity, is known as the *ecology of the region.*

The production of a region takes place in volumes of earth-space known as production systems or ecosystems.

2.02 Types of Production

There are as many types of production systems as there are types of production. The term production is applied both to the act or process of production and to the thing produced. The Allendale Dictionary states that there are "productions of the earth, of art or manufacture and of the human intellect". These productions may be classified into four main types, according to types of products and of processes. In *physiographic production* earth products such as sand, gravel and water are mined. In *biological production* such products as wheat, cattle, pine, game and fish are cropped. Through art, manufacturing and construction there is *artifact production.* Through changes in the human personality such as intellectual growth there are changes in the social, intellectual, political and religious life of a community which can be termed *societal production. Geographic production* is combinations of all four types of production. Physiographic, biological and artifact production may be measured in economic units, but the measurement of societal production requires social as well as economic criteria.

All of these four types of production may be processes within a single *human ecosystem.* All of these processes involve *relationships between man and his total environment.* Societal production within an ecosystem is affected to a lesser or greater degree by other types of production (e.g. artifact and biological) within the same ecosystem.

Since the relationships between man and his environment within the total human ecosystem present a complexity which is difficult to study as a whole, the four production subsystems mentioned above may be considered separately, providing that it is understood that these are but parts of the whole.

The biological production system is an exception to the above for it is also a whole in itself when viewed as a system of relationships between plant and animal communities and their non-living environment. In fact, plant and animal ecology became established before human ecology and many of the principles of ecology can be more easily recognized and described in the simpler biotic context. Because of the strong sociological bias which has surrounded the development of human ecology, land-use ecology has much to offer the new human ecology which is developing.

2.03 An Introduction to Ecosystems

An ecosystem is a volume of earth-space which is set apart from other volumes of earth-space in order to study the processes and products of production, particularly those transactions between a community of organisms and its non-living environment.

The non-living parts of an ecosystem are collectively known as 'physiography' which consists of both landform and climate. Landform is itself a complex consisting not only of the surface relief but all the solid and aqueous materials which give substance to that relief. Landform is the complex of geologic materials including the ground water and soil profile which exists within them. The climate of the local biotic ecosystem is known as ecoclimate and is intimately related to both landform and vegetative cover.

Plant, animal and human communities comprise the living portions of the ecosystem. Plants and animals together comprise a 'biotic' community.

Because of their relative stability, landform features are used to classify ecosystems. A series of significantly different biotic communities representing various stages in natural succession or various types of cultural practices develop on areas, the physiographic features of which do not change significantly as one biotic community is replaced by another. Thus the areal unit with which each series of ecosystems is identified is named, in part, by some significant physiographic feature such as gently sloping, dry, granitic, coarse sand. This constitutes a handle for all the features which comprise the volume of earth-space which is associated with this area or which will be associated with it as vegetation develops or as land-use changes.

Since the physiographic volume of earth-space at any specific location is capable of supporting a range of plant, animal and human communities, each physiographic site type is associated in a time sequence with a series of biotic and/or human communities. That is, a series of ecosystems develop over time upon each single physiographic type.

The ecosystems which make up the series which develop upon each physiographically defined area are differentiated by adding the name of the biotic community to that of the physiographic type.

2.04 The Role of Physiographic Units in Land-Use Ecology

The specific control which the non-living (physiographic) environment exerts upon production must be considered in (a) the recognition of the types

of physiographic units, (b) the determination of their potential, and (c) the appraisal of the degree to which the various communities are able to utilize this potential. This knowledge of environmental relationships within space and time provides the basis for predicting the results of land-use adjustment and the degree to which the natural landscapes of the past will be able to survive the pressures of the future.

The integrated system of land classification presented in Chapter 3 is essentially a classification of ecosystems. Physiographic and community units are established concomitantly in order to have a well-integrated system which provides for a classification of dynamic productivity systems.

Land-use ecology deals with changes in both the living and non-living portions of the ecosystem as it develops and as one ecosystem changes to another on the same physiographic location. Significant differences in the type of land use and even in the management practice constitutes the basis for different ecosystems. However, it is not necessary for a land-use specialist to stand on a site and wait for these changes to occur before knowing what goods and services will be produced. With a good physiographic site classification he can compare similar physiographic sites widely distributed in space. Generally, these similar physiographic types are supporting a range of communities which are sufficiently different in kind and stage of development that a comprehensive picture may be obtained of (a) the levels of physiographic potential (materials and energy available), (b) the relative capability of the various crop communities to utilize this potential, and (c) the relative efficiency of the various management practices to facilitate the utilization of potential of both physiography and biotic communities.

The maximum level of any specific physiographic feature is significant only if the levels of all the other significant physiographic features occur at the same level of effectiveness. This can be determined only if there are communities capable of utilizing this physiographic potential under practiced and practical methods of management. This means that environmental quality is not absolute but is relative to the ability of the organisms or of the community of organisms to utilize it; such utilization includes the conditioning of all the features of the ecosystem through the processes of production.

The use of integrated units of the physiographic and living environments to measure changes in the total production of an ecosystem is one of the features which distinguishes 'land-use ecology' from other types of ecology.

The preceding discussions of land-use ecology have covered in general the nature of ecosystems as productivity systems. The following sections discuss their nature more specifically under biotic and human ecosystems. Timber, deer and fish production systems are used as examples of terrestrial and limnic biotic ecosystems respectively. A further development of these concepts is presented under ecological perspectives (section 2.4).

2.1 PLANT AND ANIMAL ECOLOGY

2.11 The Nature of Plant and Animal Ecology

It may prove helpful to select from the volumes which have been written on the subject of plant and animal ecology a few highlights regarding the biotic aspects of land-use ecology.

Not all ecology is land-use ecology. In fact, not everything which is labelled ecology is ecology. Much autecology is plant physiology and much which goes under the name of synecology is actually plant or animal sociology.

Ecology is the study of the *whole ecosystem*, not the living communities in themselves nor the physiographic environment in itself. We cannot speak of ecology without talking about ecosystems. Tansley (1929, 1935) first introduced the term in 1929 and then elaborated upon it in 1935. His concept very clearly embraces a system. The prefix 'eco' is likewise generally recognized as pertaining to a combination of the living and non-living environment. Tansley pointed out clearly that climate and soil were part of the ecosystem and discussed some of the basic interrelationships between soil, climate and vegetation within the ecosystem.

Tansley, however, had some reservations concerning the faunal element of ecosystems. He implied that animals were part of the ecosystem only if they interfered greatly with the development of vegetation by heavy grazing. Tansley seemed reluctant to include all animal life within the ecosystem apparently because he was not convinced that there was an adequate integration of plants and animals within the concept of 'biotic community' in contemporary use. The possibility of orienting patterns of ecosystems from an environmental point of view so that both plant and animal communities could be 'fitted' to the physical base apparently did not come to his mind. Tansley's ecosystem was therefore more strictly a 'vegetation' ecosystem rather than a 'biotic' ecosystem.

Sukachev (1945) introduced the term 'biogeocoenose' as one which connotes the existing together (coenose) of living (bio) and non-living (geo) elements. Since ecosystem, if properly defined, has the same connotation, there is no reason for introducing another more cumbersome term. However, Sukachev has contributed much to our knowledge of the concepts and principles of ecosystems.

What the British plant ecologist, Tansley, failed to do, namely, to integrate animal ecology with that of plant ecology, the British animal ecologist, Elton (1927, 1966), has done. Unfortunately, Elton did not establish too clearly the physiographic units which supplied the matter and energy used by these integrated plant and animal communities in the production of total biomass. Clements and Shelford (1938) have attempted to integrate the two types of communities in their 'bio-ecology'.

Clements' (1928) theory of plant succession has spurred on studies of vegetation dynamics, even though his interpretation of the interrelationships

between plant communities is faulty owing to lack of understanding of the relationship between plant communities and their physiographic environment (Hills, 1960d). Tansley (1935) was outspoken in his warning to the 'drinkers of the pure milk of Clementsian doctrine'.

This outline would not serve its full purpose without reference to 'ecological energetics' which has been summarized by Phillipson (1966) and without mention of the pioneering work of E.P. Odum in setting forth the concept of the ecosystem as a productivity system and the research of his brother, H.T. Odum, in the cycling of matter and the flow of energy (Odum, 1939).

2.12 The Nature of Biotic Ecosystems

A biotic ecosystem is a life-filled volume of earth-space (Rowe, 1961) in which the ecological relationships between biotic (plant and animal) communities and their total environment are studied. When these ecological relationships involve the biological production of an area (strictly speaking a volume), the biotic ecosystem is a biological production system known as site (see Chapter 3).

An ecosystem is a single open system composed of both living and inanimate features which are constantly in a state of motion, transformation and development. Although logic demands that organisms and environment be viewed as a single system, it is impossible to study that system without a provisional separation into subordinate systems which may be more conveniently examined. Diagram 1 shows two main subdivisions, namely, the inanimate physiosystem (often called 'ecotope' by biologists) and the living biosystem (or biotope). The *physiosystem* consists of two subordinate systems - (a) the soil system which includes within it extensions of landform features such as parent soil materials and ground water, and (b) the ecoclimate system which includes the atmosphere of the soil. The *biosystem* consists of three subordinate systems - (a) green plants, (b) saprobes[1], and (c) animals. These three systems correspond approximately to the three functional groups of organisms, namely, the synthesizers, the reducers, and the consumers.

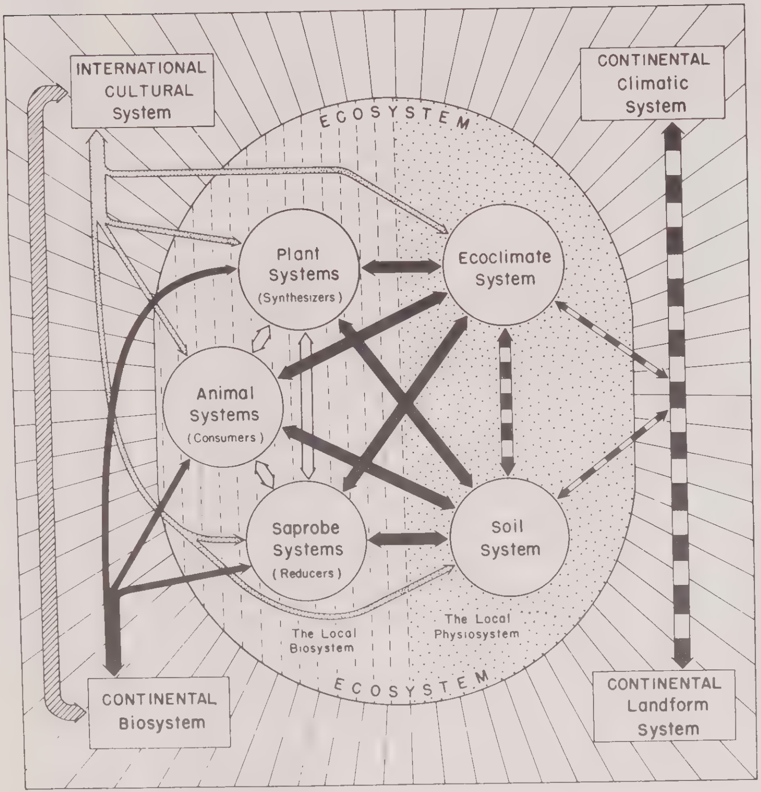
Intermeshed with this complex of local subordinate systems are extensions of four superior systems of continental or global extent. Two of these are physiographic environmental systems, namely, climate and landform. The other two superior systems are those of living organisms, namely, the continental aspect of the international cultural system, and the continental biosystem, including plants and animals from microscopic to macroscopic dimensions, but excluding man. These are called superior systems since they control, from the outside, the production within the ecosystem by supplying energy and vital materials to it.

Although all biotic ecosystems have the above characteristics in common, there is a wide range of difference in ecological relationships owing to

[1] Non-green 'plants' and other organisms, which feed by 'absorption' and function as reducers, have been placed in a kingdom separate from green plants and animals known as saprobes.

Diagram 1

THE BEHAVIOUR OF THE LOCAL PRODUCTIVITY SYSTEM



LEGEND

ECOSYSTEM
The local Productivity System

SUBORDINATE SYSTEMS
Together constitute the Ecosystem

SUPERIOR SYSTEMS
Maintain, or disturb, the steady-state of the Ecosystem.

TRANSACTIONAL* PROCESSES WITHIN THE PRODUCTIVITY SYSTEM

Transactions between the local biotic and physical system.

Transactions between the local biotic systems

Transactions between the local physical systems.

TRANSACTIONAL PROCESSES WHICH MAINTAIN OR DISTURB THE STEADY STATE OF THE ECOSYSTEM

The international cultural system.

The continental biosystem

The continental physiosystem

TRANSACTIONAL PROCESSES BETWEEN TWO SUPERIOR ORGANISMAL SYSTEMS

Transactions between the cultural and biotic systems

*Transactions are mutually dependent interactions

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to differences in the physiographic environment and the communities which occupy these. These variations in ecosystem can be best discussed in terms of differences in communities providing that these communities are differentiated in all of the following characteristics:
(a) number of species and individuals
(b) size of individuals
(c) activities (these include all transactions with the physiographic environment).

Thus a jack pine-dry-sand ecosystem differs from a jack pine-massive-clay ecosystem not only because of differences in the soil materials but because of differences in the 'activities' of the organisms in the two jack pine communities.

Ecosystems may also be differentiated on the point of view taken by the observer. The same area, if of sufficient size, may be divided in more than one way depending upon whether the ecosystem to be considered is a timber productivity system, a deer productivity system, or some other productivity system.

In the following sections, the forest productivity system focusing upon timber production will be discussed first since it has the simplest form. It will also be discussed in greater detail to illustrate ecological principles. This is made possible by the large amount of available data on forest production.

The more complex 'deer' ecosystem will introduce the complexities of the wildlife ecosystem. Doubtless, a wolf productivity system would be more representative of the total environmental relationships within a terrestrial ecosystem because of the predator position of the wolf in the food chain. However, deer production is a more common land-use practice than wolf production.

2.13 The Forest Productivity System

A forest ecosystem consists of a biotic community defined and located by means of a forest community of trees and lesser vegetation.

Forest production is dependent upon processes which transform and transmit energy and matter within and between forest organisms and their environment. Trees and other green plants synthesize organic matter from the energy and materials transmitted to them by the atmosphere and the soil. Other organisms consume and reduce organic matter, thus transforming and releasing energy and matter for another cycle of forest growth. Soil, in its true sense, is the activated portion of the surface geological materials which releases the energy and matter of the non-living organic and inorganic materials and transfers these to the plant roots. The atmosphere transfers the solar energy of the sun to the organisms and facilitates the exchange of energy and matter within the forest and the soil.

Thus forest production is a complex of interdependent processes operating within an assemblage of living organisms and their non-living environment. Such assemblages of forest organisms and of soil and atmospheric features, occupying specific portions of the earth's surface, and unified by the processes of forest production, are termed *forest productivity systems* (Hills 1952, 1953, 1960c).

Production within a forest productivity system is not necessarily confined to increments of merchantable wood, but to all changes within the ecosystem, including changes in the soil profile. This concept applies equally well to multiple-use considerations.

Forest productivity systems are known under various names. Sukachev (1958b) of Russia has written a masterly exposition of the complex inter-relationships of the many components of the biogeocoenose. Rowe (1960) presented proposals for the role of productivity systems in forestry under the name of ecosystem. Hills (1958) used the term 'total site' in order that the entire productivity system be connoted. Neither forests nor physical features are, in themselves, productivity systems.

Certain physiographic features, namely, regional combinations of geological materials, relief and climate constitute the potential control of the kind and rates of biological activity.

The actual biological production of an area, however, is dependent upon the capacity of the organisms, which have successively established themselves upon it, to develop the potential inherent in the above-mentioned physiographic features (Hills 1960a).

Broad differences in vegetation succession reflecting changes in macroclimate[1] are responsible for major differences in soil profile types. Local changes in vegetation, recognized as 'forest succession' are usually responsible for minor changes in soil horizons only, but, in certain cases, they are associated with major profile changes. Local effective climate is another local physiographic feature which varies with changes in vegetation.

Forest productivity systems are dynamic systems in which both biotic and physiographic features are changing within the limits imposed by the 'matter-and-energy' potential of the land and the 'genetic' potential of the forest organisms. The physiographic and the living components of the ecosystem are so intimately associated that they cannot be considered separate or *apart* from one another, yet so fundamentally different that they cannot be considered *a part* of one another.

2.14 Deer Productivity Systems

A deer ecosystem is that portion of the earth's surface occupied by a community (herd) of deer. Owing to shifting habits of the deer community, it is difficult to separate the areas occupied by each community. Clements and Shelford (1939) did not attempt to separate each deer-herd ecosystem but established, rather, a regional ecosystem, *viz*. the Eastern North American Biome, which includes most of the land occupied by herds of deer and the animals associated with them. Such areas are too large and with characteristics too

[1] Macroclimate - the regional climate, not modified by local differences in landform and vegetative cover.

variable to be of much assistance in land-use studies; a smaller area, with boundaries and quality of features capable of definition, must be arbitrarily established. Its minimum size must be sufficient to accommodate a small herd without reduction of deer production. It must be comprised of a pattern of land units which have the potential to ensure the diversity needed to provide food, cover and protection, both in summer and in winter. If large enough, 'homogenous' patterns meeting these requirements may be considered as distinct ecosystems.

Since the boundaries of deer ecosystems must be arbitrarily established, a terrestrial biotic ecosystem which embraces all types of biological production is proposed. These can be viewed from whatever aspect the land-use planner wishes to take.

Direct physiographic controls of deer production are limited to such factors as local climate in critical seasons. Indirectly, the physiographic features are significant parts of the totality determining plant communities in which the deer feed and are sheltered from the weather. Also, the combined interaction of physiography, vegetation and animal communities determines the type of predator community and thus exerts an indirect control on deer production.

2.15 Terrestrial Biotic Ecosystems

The above discussion of forest and deer production units suggests a simplified approach to considerations of both timber and deer production within one ecosystem. To simplify matters, only those ecological relationships which are most pertinent to the production objectives are used to define the system. Other factors are considered to be 'external' to the consideration. For example, in some stages of forest successions, deer communities have a profound effect on the forest community; for example, on the survival of yellow birch regeneration. Likewise, in some regions certain forest types such as hemlock may have a high potential as wintering yards for the deer.

Only two of the many ecosystems established for the purpose of land-use analyses have been mentioned. Since all of 'land-use' ecosystems are components of total production system, it would seem logical to establish terrestrial biotic ecosystems which would be convenient for an analysis of the total biological production; that is, of all the biotic land uses.

The hierarchical system of land classification presented in Chapter 3 provides such units at various levels; for example, land units are useful in considering deer ecosystems. Generally, the natural landscape units have been found to be convenient units for assessment of deer production by integrating those of the various land units. However, some wildlife ecologists (Thomasson 1968) finalize the rating of the potential of the land for deer production at the land unit level.

Within such physiographically defined areas there are generally several plant and animal communities which have significance in deer production.

The various forest and grassland communities which provide food and cover are characterizing features. Wolf packs and other predators are an important part of the deer ecosystem.

2.16 Limnic Ecosystems

Limnic ecosystems include all water bodies on continental areas, most of which are fresh. The main difference between limnic and terrestrial ecosystems is that the organisms live most of their lives in a water rather than an air medium.

In terrestrial ecosystems, the hydrosphere permeates the other physiographic spheres of landform, soil and climate. In limnic ecosystems, 'soil' and 'climate' are found within the hydrosphere. Since the nutrient elements of the limnic ecosystem are found not only in the bottom sediments but throughout all water strata, aquatic organisms actually live *within* the limnic soil profile.

The inclusion of the nature of the materials as well as the character of their relief within the concept of landform has become well established in land-use terminology because these two aspects are interrelated in their control of terrestrial biological production. Unfortunately, the concept of morphometry, the corresponding term in limnology, is limited to the physical dimensions of size and shape of the containing basin of the water body. Apparently the fact that the soil nutrients in the water body are only partly derived from the inorganic materials which constitute this containing basin has lessened the need for broadening the concept of morphometry. Furthermore, the nature of the soil nutrients in the water body is determined in large part by the character of the landform of the drainage basin of which the water body is a part. Therefore it has been deemed practical to broaden the concept of landform to include both the relief and materials of the containing basin as well as that of the entire basin. Thus morphometry of water bodies is one of the many aspects of landform.

The relief aspects of the landform of the areas immediately surrounding the water body also affect the climate immediately over the water body, particularly such features as the velocity, temperature and vapour content of the wind.

The organisms of the limnic ecosystem have been classified as:

(a) Plankton - relatively small size with no (or small) power of locomotion;
(b) Nekton - larger organisms which swim freely and are largely independent of water movement for their distribution;
(c) Benthos - live in or on the bottom sediments;
(d) Seston - a term used to connote the whole heterogenous mixture of living and non-living bodies which float or swim in the water.

A spring-fed pond or small lake with an outlet but no inlet provides an easily definable example of a fresh water ecosystem. It may be broken up into various benthos and seston ecosystems. Such a water body may be considered a fish productivity system. The difference between a limnic ecosystem and a

fish productivity system is entirely in the point of view. In the latter case the fish population constitutes the focus of study; only those features which are known to have significance in their production are used in the classification. However, since some fish species occupy the highest trophic level in the food chain, most of the features in the total ecosystem are significant in fish production.

2.2 HUMAN ECOLOGY

2.21 The Nature of Human Ecology

Geographer Barrows in 1922 introduced the concept of geography as 'human ecology' defining the latter as the relationship of people to place. However, a year earlier, sociologist Robert E. Park introduced human ecology as the relationship of people to people, using the concept of that school of plant ecology which restricts its study largely to the relationship of plant community to plant community. On pages 27 and 28 of their book, "American Geography, Inventory and Prospect", 1954, James and Jones stated the need to fuse the concepts of the people-to-place ecology of the geographers and those of the people-to-people ecology of the sociologists and to add the place-to-place descriptions of the physical geographers. Needed today is a human ecology which deals with people-to-place relationships within and between places.

Recently, the sociologist and the regional planner have adopted the holistic concept of ecology but generally without concrete expressions of the ecosystem. Dr. Leonard Duhl, a medical doctor working as a specialist in housing, has this definition of ecology in his article, "The Parameters of Urban Planning", in the symposium, "Planning for Diversity and Choice": (Anderson ed. 1968)

> "'Ecology' may be defined as that inter-intra confrontation of biological, psychological, physiological, social, and historical factors that embrace one's family, school, neighborhood, the many overlapping communities that teach values, defenses, and offenses, the meaning of oneself and one's existence. Ecology contends that as man creates and alters his environment, he in turn is affected by that environment. For example, many of the pressing social and economic problems of the aging today exist because of advances made in the field of medicine. 'Ecology' connotes *wholeness*--that all has effect on all else, that education is tied to housing to transportation to employment to discrimination and on and on."

To implement the issues which arise from this very excellent definition of human ecology, there is needed a comparative study of the totality of human ecosystems in time and space.

The physiographic classes used to differentiate ecosystems upon their non-living features must be designed to provide units of convenience for comparing the response of human communities to the totality of the same physiographic

unit at different times or to units differing in their physiography at the same time. To accomplish this differentiation, the classes must be subdivisions of gradients based on levels of significant features, as has been advocated by Farrar (1960) for biotic ecosystems.

2.22 The Nature of the Human Ecosystem

A human ecosystem is a life-filled volume of earth-space in which the ecological relationships between man and his total environment are studied.

Any small volume of land is part of both biotic and human ecosystems. It is part of a biotic ecosystem when it has been 'isolated' from the surrounding area for convenience in studying the relationship between plants and animals and their environment, particularly as members of a biotic community. The same small volume of land is part of a larger human ecosystem when the area of which it is a part has been 'isolated' for convenience in studying relationships between man and his environment.

It is conceivable to have at least four types of geographic (human) ecosystems based on the four main types of production, namely, physiographic, biological, artifact and societal (section 2.02). Rarely, however, are there human communities which have only one of these main types. For example, there is generally biological, artifact and societal production in resource-based recreational communities in spite of the fact that the key production is societal.

Thus a human ecosystem is usually a system of several types of production. In areas of primary production such as mining, farming, forestry, etc., the factor of societal production might not appear to be an important consideration: yet, even here, the development of human resources cannot be overlooked. Most urban ecosystems are a highly integrated complex of many human communities identified by legislative, political, moral, cultural and occupational criteria. The same individual may be part of several local communities (a) at the same instant, (b) at different times of the day, (c) at different seasons of the year. Many people work in one community, reside for most of the year in another and spend their holidays in a third, fourth, etc.

However, in land-use planning and regional development it is necessary to establish boundaries of human ecosystems arbitrarily, using the best available criteria. These criteria are difficult to set down explicitly, for each situation has some unique characteristics. There are, however, two series of areal units which should be used in combination with one another, *viz.* the legislative and the ecological.

The legislative units are those areas whose boundaries indicate the limits of the jurisdiction of a decision-making (legislative) body. These boundaries are usually well defined but are frequently not coincident with natural land boundaries. At the present time there are only two levels in Ontario - the province and the municipality (city, town or township). Only in these units are there legislative bodies who can make land-use decisions. It is hoped that, in the near future, land-use adjustments can be made and

implemented at the regional level which is intermediate between the municipality and the province.

The other series of units, ecological, are based on patterns of physiographic site associations. These are units such as the land units, landscape units and regions discussed under Land Classification (Chapter 3).

As stated above, it is necessary to examine the ecological variation within each legislative unit. In most cases there is more than one ecological land unit in each legislative unit. These should be considered as subdivisions of the legislative unit for planning purposes.

One of the most important phases of human ecosystem studies, outside of the field of geography, is ecological energetics which has been summarized by Phillipson (1966).

The following discussion of ecological perspectives develop further the nature of the human ecosystem.

2.3 THE ECOSYSTEMIC BASIS OF LAND-USE PLANNING

Ecological land-use planning is the process of developing a plan of action from mental formulations applying ecological principles. In order that the mental formulations be amenable to ecological analysis and synthesis, they must be constructed with an ecological perspective. This same perspective must be used in making the best decisions. In the implementation of the decision, action must be guided with the same perspective.

The principles are based on the nature of the ecosystem and the interrelationships which operate within them (see preceding section). The perspective is gained from a knowledge of ecosystems and a recognition of those principles which are applicable.

The following are the basic characteristics of the ecosystem from which principles are drawn and from which perspectives are obtained:

(a) Ecosystems are *real* but are known only through the experience of the investigator. Decisions regarding their behaviour can be made only through value judgments.

(b) Ecosystems are complex wholes which are *more than a sum of their parts*.

(c) Ecosystems are systems of *circular causality and resultance*, owing to the transactional nature of the relationship between the various parts.

(d) Ecosystems are *dynamic*; they change over time.

(e) Ecosystem units may be established by processes of either *integration* (grouping) *or differentiation* (subdividing).

(f) Ecosystems are characterized by a *central core* or dominating node or a series of nodes; their boundaries are lines of convenience between the core or cores of one ecosystem and those of adjacent ecosystems.

(g) The development of ecosystems is controlled by combinations of natural and human features. In the biotic ecosystem, the natural controls dominate but seldom are the human controls completely absent. In the human ecosystem, the human controls dominate, but seldom override the physiographic controls completely.

In the following discussion of perspectives the above concepts will be developed further and applications will be presented. This will be followed by a discussion of the preparation of a land-use plan and the steps to be taken in applying the principles.

2.4 THE ECOLOGICAL PERSPECTIVES IN LAND-USE PLANNING

The following are the five main perspectives in ecological land-use planning.

2.41 Ecological Perspective A: The nature of knowing and of making decisions

2.411 Concept. Dewey and Bentley (1949) speak of transactional observed behaviour in which knowings are the organic (human) phase - the knower, and knowns are the environmental phase - the things known. In observing the behaviour (or nature) of things there is a transaction between the observer and the 'thing' observed.

Dewey and Bentley reject both the terms 'subjective' and 'objective' because of confused connotations. Furthermore, these philosophers claim that the observer must become part of his knowing. Knowledge cannot be gained except 'subjectively' but Dewey and Bentley prefer to speak of it as being 'transactionally' obtained.

2.412 Application. Ecological land-use planning is not a science *per se*, nor a technology *per se*, nor even a philosophy *per se*. It is a combination of all three within the context of human welfare decisions. Such decisions, in common with all other important societal decisions, are in essence *value judgments*. They are made in the light of all economic, scientific and technological facts available and with considerations of all the known philosophical arguments, but the ultimate decision is one of value judgment.

This fact was emphasized in the 'February 1969 Monthly Letter of the Royal Bank of Canada' in the final section which is quoted below.

> "Man, part of nature, has become enticed into a nearly fatal illusion: that his skills in science and technology make him independent of the laws of nature.
>
> "He spreads insecticides without examining into whether they would be fatal to birds and beneficial insects and might kill people. He poured millions of pounds of detergents into rivers before learning that they polluted the water. He allowed lakes to die of oxygen starvation. He contributed to the deadliness of smog by floating noxious substances into the air.

"What is required is a *value judgment* which compares the known risks with the anticipated benefits. This is where conscience and intelligence enter the scene. Said Barry Commoner in his powerful article entitled, "Pollution: Time to Face the Consequences", in the midsummer 1968 *Think*: 'No scientific procedure can tell us how many defective births from fallout radiation we ought to tolerate for the sake of a new nuclear weapon.....No scientific principle can tell us how to make the choice--which may be forced upon us by the insecticide problem--between the shade of the elm tree and the song of the robin.....The necessary judgments are therefore the responsibility, not of scientists and technologists alone, but of all citizens.'"

In order to fully utilize the findings of science and to profit from the experience of technologists, the land-use planner must orient these within the ecosystem framework. He must have an ecological perspective which is not derived solely from philosophical discussion but one which combines this with comparative observations of ecosystems in production.

2.42 Ecological Perspective B: Transactional behaviour between the parts of the 'ecosystemic' whole produces a circular resultance which demands that the whole be considered greater than the sum of its parts

2.421 Concept. An ecosystem is a whole[1] which is more than the sum of the features of the subordinate systems which comprise it. Not only do the specific transactions between the subordinate systems bring out latent characteristics in each, but the ecosystem as a whole takes on a behaviour which is not explainable from the characteristics of the individual subordinate systems. This applies equally to a rating of subordinate systems as part of one or of several ecosystems.

Thus the level at which each feature of the subordinate system exists cannot be assigned a useable mathematical value without modification to determine the function of the feature in all ecosystems.

Since the transactions within an ecosystem are mutually dependent upon both organisms and environment, there are no 'cause-and-effect' processes (as traditionally conceived) either within the ecosystem or between the local ecosystem and other ecosystems. Within the local ecosystem, transactions result in changes within the ecosystem itself. Such changes are the result of the behaviour of the entire ecosystem and not of any specific part of it. The entire system operating over a specified period is the 'causal' factor and the pattern of changes which have occurred within that system during that period is the 'resultant'. Thus, an ecosystem is both a *circular causal system*[2] and a *circular resultant system*.

---

[1] For a discussion of wholes see Hartshorne (1939), Smuts (1926), Phillips (1934, 1935) and Egler (1942). Be careful to distinguish between the discrete physiological wholes of Smuts and Phillips and the transactional wholes defined in this paper which follow more closely the concept of Wörner's (1938) psychological wholes discussed by Hartshorne (1939).

[2] See Hutchinson (1948) for a discussion of circular causal systems.

(The ecosystems under discussion are parts of the continuum of features at the earth's surface which are separated from one another as 'mental isolates' and which are later definitely located by arbitrary boundaries for convenience in land-use planning.)

2.422 Application. An example of this principle is the development of a podsol soil profile during several rotations of pine. Contrary to the cause-and-effect school of thought, the white pine in itself did not cause the podsol profile. Podsols are not found under white pine under all circumstances, for in certain climatic regions they are found under pine on some soil materials and not on others. Neither is parent material the cause of podsol profiles since podsols do not consistently occur on specific parent materials in all climatic zones. Nor is climate the cause since podsols are not found on all materials under all vegetation types within any climatic region.

Actually, the cause of the podsol soil profile development is a number of mutually dependent interactions between a specific combination of vegetation (and associated biota), landform and climate operating during a definite period of time. In other words, the podsol was caused by the total transactions of the ecosystem during the development period.

A simple example taken from human ecology is the outstanding production of a 'high-yielding' variety of potatoes on excellent potato land. The high production was not due to the genetic potential of the potatoes alone, for on some lands the production would be very low. It was not due to the capability of the land in itself for without good seed and good management production would doubtless be mediocre even on excellent land. The high production was the result of all these groups of factors--land, man and crop--no one of which can be rated without reference to the other two.

Other examples of the need of a holistic perspective are in the area of social preferences and institutional controls which are not as easily assessed. It may be sufficient to say that the transplanting of a social or technological custom, from one continent to another, or from one country to another, or even from one part of a country to another part with a different physiographic environment, have met with varying degrees of success due to differences in the nature of the wholes in the two places. The failure to establish a southern Ontario type of agriculture on the Cochrane Clay Belt of northern Ontario illustrates this principle (Hills and Boissonneau 1960).

2.43 Ecological Perspective C: The use of gradient classes of physiographic and biotic and cultural features to classify and evaluate ecosystems in time and space at various levels of integration and differentiation

2.431 Concept C[1]. All the living and non-living features which exist together within those volumes of earth-space known as 'productivity systems' are each part of continua of universal extent. It is possible to arbitrarily break these continua into segments at a common boundary. This results in the setting apart of (differentiating) one area from another by coincidences of different levels of

significant features. Within each area so differentiated, there are thus portions from many continua which interact transactionally during the process of production. The kind, quality and rate of production provides the basis for differentiation or integration, whichever viewpoint is taken. In actual practice, both the operations of subdividing and of grouping are performed at the same time.

2.432 Application of Concept C^1. See Chapter 3 for the establishment of physiographic site types on this principle.

2.433 Concept C^2. The continuum which constitutes the global ecosystem may be divided at several levels into ecosystems by classes of physiographic, biotic and cultural features. These classes represent significant differences in levels of these controls of production established along gradients or scales determined by organized series of observations within specified areas or regions.

2.434 Application of Concept C^2. From field observations of the relationships between physiography and vegetation, coordinated at both the broad and local levels simultaneously throughout the province, Hills (1960d) subdivided the Province of Ontario into site regions based on classes from continental gradients of atmospheric temperature and moisture. A review of differences in physiography-vegetation relationships within the site region revealed that the most significant controls on the species' composition and growth of vegetation within a region were (a) local climate (ecoclimate) controlled by landform and (b) soil moisture regime.

2.435 Concept C^3. Associated with each physiographically defined unit resulting from observations of physiographic-vegetation relationships, there is a series of biotic and human communities. These communities are separated from one another in space by differences in the physiography (boundaries having been established concomitantly). The vegetation which forms a continuum upon each physiographic unit over a period of time is separated into units using a biotic gradient, in the case of natural succession, or cultural gradients, in the case of change of cover by cultural practices.

Assuming that the entire area of each physiographic type has had a uniform history of disturbance, in the case of natural vegetation succession, and a uniform history of management, in the case of cultural land uses, the boundary of the biotic or human community will be coincident with that of the physiographic types.

Since the timing of natural or cultural successions is seldom uniform from one locality to another, indeed from one part of an ecosystem to another, most of the differences which characterize a stage in the time sequence may be found concurrently but separated spatially.

2.436 Application of Concept C^3. The recognition of physiographic control of natural succession enables the plant ecologist to determine the time sequence of natural community development by observations of numerous communities on the

same physiographic site from place to place rather than the vegetation change from time to time on the same place. The land use ecologist does not need to stand by and wait for one community to change to another.

2.437 Concept C^4. Ecosystems identified by classes from one or more physiographic gradients (according to objective) provide a useful framework for observing, recording and predicting differences in all types of production.

2.438 Application of Concept C^4. Physiographic site types (see Chapter 3) established by relating physiography to forest development have provided a basis for recording production under various physiographic and technological controls. This ability to predict the production of physiographic site types was demonstrated in northern Ontario where there was a sufficient number of relatively undisturbed forest stands to be used as benchmarks and all stages in the vegetation succession were either represented or could be established by interpolation. These provided for the basic benchmarks of production of the relatively stable (climax) stands. Initially, these were assumed to represent the potential of the site, but as studies were intensified, it became apparent that stands occupying pioneer or intermediate stages of succession may have a higher rate of production. Thus,a successional pattern of potential productivity was established for each physiographic site.

The above principle was first extended to include managed forest stands and then to all forms of natural area uses.

Physiographic control is not as great on some forms of societal production as it is on biological production.

2.44 Ecological Perspective D: Differentiation of ecosystems on the basis of degree of homogeneity of function achieved either physiographically, biotically or culturally

2.441 Concept. Ecosystems are aggregations of volumes of earth-space which are separated from other aggregations on the basis of homogeneity of function.

In physiographically homogenous areas, the ecosystem lies within a single class of each of the gradients used to describe it. The characteristic of a class, which is part of a gradient, is that the point of greatest difference between it and the classes above and below it on the gradient, is found in the central core of the class with gradations in either direction until a point is reached where the individual is more like the core of that class than the core of the next class and its neighbour is more like the core of the next class. This is a characteristic of all classifications.

In the case of an ecosystem which is biotically homogenous, the ecosystem lies within a single class on a biotic gradient but may coincide with a number of physiographic classes. Hence, the unifying features are biotic.

In the case of an ecosystem which is culturally homogenous in the simplest form, the ecosystem lies within a single class on a cultural gradient. It may be coincident with a number of physiographic and biotic classes.

In the more complex human ecosystem (i.e., the landscape unit and the region) cultural homogeneity is expressed by the type of clustering around a node or nodes. These nodes may be of various types. Some are growth centres, others centres of various specialized activities. The factors which give homogeneity to the landscape unit and region are discussed under these headings in Chapter 3.

2.45 Ecological Perspective E: The development of human ecosystems are controlled by an integration of public welfare, institutional and natural environmental features

2.451 Concept. No satisfactory classification and evaluation of land can be made, no sound management or land-use decision can be made without a consideration of all the features which interact to control geographic production.

2.452 Development of the Concept. The interrelationships between the public welfare, institutional and physical environment controls within the human ecosystem are shown in Diagram 2[1].

This diagram emphasizes the fact that in all land-use considerations all three groups of factors exert some control. For example, theoretically in land capability ratings there may be up to 20 percent of non-physical control, either welfare or institutional or combinations of the two. The percentages proposed in the diagram are to be used figuratively since this three-dimensional diagram is an attempt to generalize a multi-dimensional situation.

Some Comments on the 'Natural Environment' Corner

(a) Natural environment: classification of land on its natural or inherent characteristics.

(b) Land-use capability: a rating of the potential production of an area which can be realized under specific institutional and welfare controls.

An ecological system of use capability ratings is established by considering all the known levels of present production on the same types of physiographic sites throughout a region and the variations in levels of production on each physiographic site relative to variations in management practices and the institutional and welfare controls.

Note: Present production data is of value in establishing use capability ratings only if related to the potential of the land under defined conditions.

(c) Present ecological development: rated chiefly from the viewpoint of plant-animal communities. For example, stages in natural vegetation succession and the physiographic and biotic conditions of culturally controlled ecosystems.

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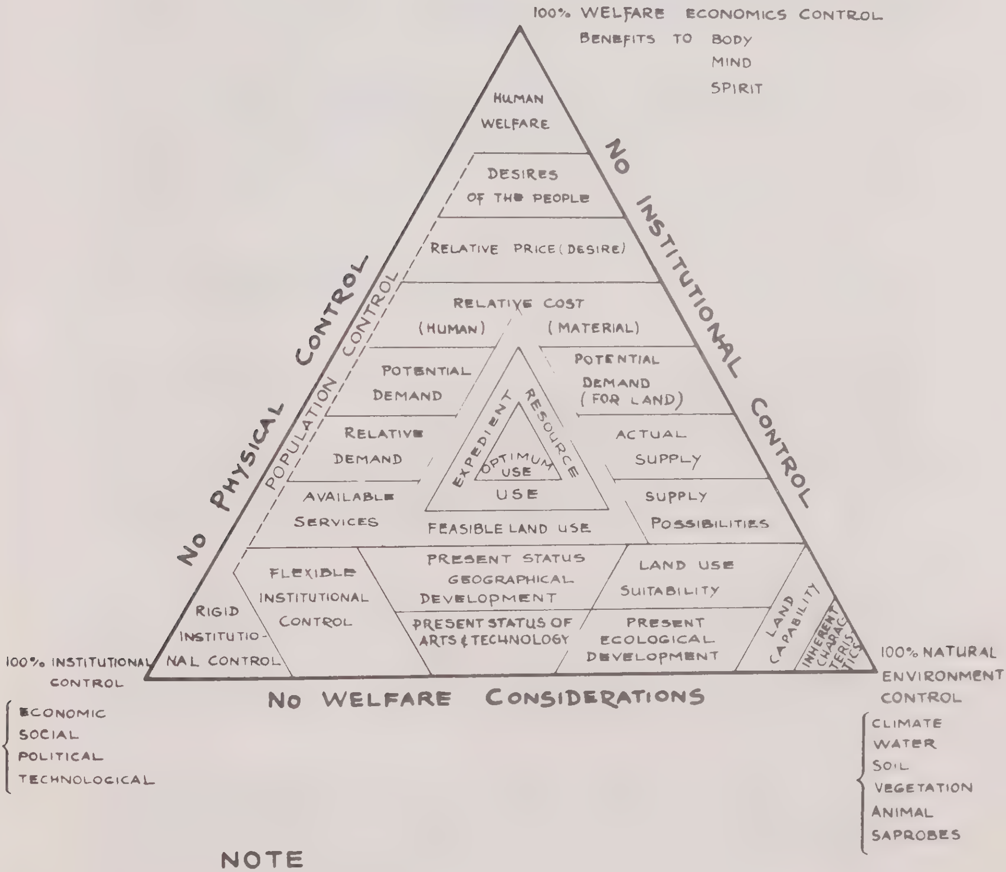
[1] This diagram was suggested by one presented by J. F. Timmons, Professor of Economics, Iowa State College at a seminar at OAC Guelph in 1957. The diagram has been revised so drastically that Professor Timmons should not be held responsible for any discrepancies in the present form.

Diagram 2

THREE DIMENSIONAL FRAMEWORK FOR INTEGRATING GRADIENTS OF PHYSICAL, INSTITUTIONAL AND WELFARE CONTROLS OF LAND USE.



NOTE

THE TIME DIMENSION IS NOT INDICATED IN THIS DIAGRAM.

G. A. Hills

March 1969

(d) Land-use suitability: the comparative opportunity for a specified production on a specific area, considering (i) the comparative levels of production (either optimum or otherwise acceptable) together with (ii) the comparative degrees of technological effort required to obtain these production objectives.

(e) Present status of geographic development: the stage in the development of the human ecosystem[1].

Some Comments on the Population-Controlled Base. This is the 'strip' which includes both the 'welfare' and the 'institutional control' corners and the intervening area left of centre on the diagram.

The categories shown are largely paraphrases of those used by Professor Timmons presumably with the same meanings. Although economics is a study of *value* not necessarily *money*, most economists insist on interpreting cost-benefit ratios in terms of dollars and cents (it is easier that way). However, as pointed out in the monthly letter of the Royal Bank mentioned above (Section 2.41), what is required is a "value judgment which compares *known risks* with the *anticipated benefits*".

In order to demonstrate the bipartite nature of economic controls, human welfare[2] (equivalent to welfare economics) has been assigned the 'peak' position and 'strait-jacket' economics is included with the other institutional controls.

Some Comments on the Central Core. This deals with goals of land-use planning, namely, the land uses recommended in the land-use plan. The recommended uses are of two types, namely, expedient and optimum, which are selected from a number of alternative feasible uses.

(a) Feasible land use: the relative advantage of managing an area for a specific use or uses having regard to a combination of its capability and suitability for this use under existing or forecasted socio-economic conditions.

(b) Expedient land use: that use chosen by a governing body to meet a desired goal. The term 'expedient' has two connotations: (i) a derogatory one meaning 'makeshift' and (ii) a respectable one meaning 'fitting' or 'advantageous'. Which one of these is applicable will depend on whether the goal is planned to meet the welfare needs of the constituency in so far as present demands and finances permit or whether the goal is chosen as a stop-gap endeavour to avoid the real issue.

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[1] Although geography is human ecology and the ecological approach applies equally to biotic and human ecosystems, the term ecology on the chart is restricted to the plant and animal ecosystem and geography to the human ecosystem.

[2] See R. J. Ely, et al., (1933) Foundations of National Prosperity, for discussion of the human power of the body and of the spirit.

(c) Optimum land use is that feasible use which in the opinion of the decision maker provides the greatest increment of public welfare.

2.5 THE LAND-USE PLAN

2.51 The Multi-Dimensional Aspects of a Land-Use Plan

A land-use plan is as complex in form and as dynamic in time as the ecosystems with which it deals. It is:

(a) A *mental formulation* of human welfare to be accomplished at three levels of generalization:
  (i) Goals--expressed by white papers and policy statements;
  (ii) Objectives--expressed by scenarios which place statements of objectives in proper perspective;
  (iii) Targets--expressed by a comprehensive plan.

(b) *Alternative scenarios* developed through modulation at various levels.

(c) A *selected comprehensive plan* (from alternative scenarios).

(d) A *program of implementation* of the plan through the establishment and attainment of targets.

(e) The *attainment of the desired level of welfare* in the human ecosystem.

Thus the term 'plan' is applied to several thought and action processes and to the product of all of these processes, namely, the actual production system or 'ecosystem' providing the anticipated human welfare. To complicate the connotation further, none of these processes is static; they change both in rate and in kind. As the original design on paper is being implemented, the knowledge gained, either by this experience or from other sources, necessitates changes in the original design. As the planner attempts to change the constituency, he himself is changed. These changes should affect the detail only; the overall aim of the goal should remain firm. This corresponds to the 'steady state' which characterizes dynamic ecosystems.

In spite of its many-dimensional aspect, the ultimate and only concrete plan is one which is implemented. A plan which is to be implemented on public or diversely owned private lands for public welfare must be approved by the governing body, which in Ontario is the Provincial Legislature and the municipal council at two levels, namely, local and regional. Until it is approved, a plan, even though graphically expressed on paper and modulated by many authorities, remains only the conceptual expression of a mental formulation, that is, a scenario.

2.52 Goals, Objectives and Targets

2.521 Goals. A goal is a concensus at the national or provincial level of that which is 'the good' for the constituency at this level of generalization. The statement of goals must of necessity be synoptic, but this lack of specificity does not mean that the goals themselves are unreal.

The government may choose a number of means by which to communicate goals to the constituency; for example:
(a) Design for Development, Robarts, Prime Minister of Ontario (1966).
(b) Design for Development, Phase Two, Robarts and McKeough (1968).

2.522 Objectives. An objective is a more specific statement than that of goals for one or more of the following reasons: (a) objective applies to a smaller constituency; (b) objective applies to a narrower field of welfare; (c) objective is framed by an authority with greater detailed understanding of immediate needs. Objectives are expressed usually in qualitative rather than quantitative terms.

2.523 Targets. A target is a statement of planned achievement of public welfare in both quantitative and qualitative terms. Targets are more specific than objectives for the following reasons: (a) targets relate generally to a portion of a constituency; (b) targets relate to specific periods of time and specific parts of an area; (c) targets are established by dialogue between management and administrators, and between administrators and policy makers. The operational phase of a resource management plan expresses the intent of targets for any specified short period.

2.53 Scenarios

2.531 Definition. The concept of a scenario as a planning tool has been widely publicized by Kahn and Wiener (1967) through their book, "The Year 2000". These authors define scenarios as "hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points. Scenarios answer two kinds of questions: (a) Precisely how might some hypothetical situation come about step by step? (b) What alternative exists for each factor at each step to prevent, divert or facilitate the process?"

Kahn and Wiener's reference to a scenario as a "hypothetical sequence of events" is not applicable to the 'scenarios' of ecological land-use planning. Scenarios differ according to the objectives set forth. Whatever the objectives are, scenarios express a series of integrated objectives for preserving the environment, the fulfilment of which is dependent upon timing as an 'urgency', rather than as a 'sequence'. For example, some of the strategic natural-use areas shown on scenarios really exist on the ground today, but will not be found anywhere in the year 2000 unless they are reserved now. Such action must also apply to additional areas to complement those now existing. These actions may be construed as a sequence of events, but, contrary to Kahn and Wiener, are by no means 'hypothetical' unless, of course, they are not incorporated in a comprehensive plan for implementation. In any case, they do express 'real' needs.

The retention of the name 'scenario' for such models, in spite of the above discussion, is defensible because they do express idealized pictures of the role which landscapes must play if present and future populations are to enjoy the heritage which is theirs.

2.532 The Role of Scenarios. A land-use plan is the concrete expression in map and text form of objectives which are considered desirable by a governing body which has the power to approve and implement the plan. Superficially, it might appear that there could be little affinity between the imaginative, impressionistic picture of the "unknowable" future presented by a scenario and the practical and feasible scheme of developmental targets arising out of a land-use plan. However, if the objectives of a land-use plan have not originated within the matrix of a scenario, the plan is not an instrument of development but a strait-jacket which is just as impractical as the scenario and much more damaging. Such unimaginative plans are responsible for establishing legislation and institutions incompatible with human well-being.

In order that scenarios fulfill their function as catalysts in the development of plans for improving the welfare of the people, certain assumptions must be made regarding predictions of the changes in the needs of the people between the present and the year for which the scenario is being prepared. It is also necessary to make assumptions respecting needed changes in the controls (legislative and otherwise) of human activities in the same period. Thus the necessity of a clear definition of planning contexts.

Since more than one kind or intensity of change in needs may be predicted, every one of which has some merit, it is advantageous to have alternative scenarios. Unfortunately, preparation cost limits the possibility to three at the most. Adequately documented with proposals and the assumptions under which they are advanced, such alternative scenarios provide the decision makers with the kind of background which enables them to make wise decisions.

2.533 The Modulation of Scenarios in the Development of a Land-Use Plan. Modulation in land-use planning is the modification of any aspect of a land-use plan in order that it more nearly expresses the constituency's interpretation of the relevant goals and objectives. Modulation must be carried out by all the communities which comprise the constituency in order to keep each part of the plan in proper measure or proportion relative to the whole.

From another point of view, modulation is the regulation of the various controlling factors, namely, natural environment, institutional control and public demands (section 2.45) in such a way that the optimum porportion of public welfare may be obtained. An example of modulation is presented below.

2.54 A Simple Modulation Model

In order to demonstrate the process of modulation as it applies to the development of a comparatively simple plan, an illustration has been drawn from operations which characterize planning within the Ontario Department of Lands and Forests.

This plan is simple in that it deals with development of public lands only. Furthermore, it deals only with timber production but within the context of multiple use of renewable resources which come generally within the jurisdiction of the Ontario Department of Lands and Forests.

DIAGRAM SHOWING THE COMMUNICATION AND MODULATION NEEDED TO PREPARE A PLAN FOR THE INTEGRATED DEVELOPMENT OF RENEWABLE NATURAL RESOURCES ON PUBLIC LANDS

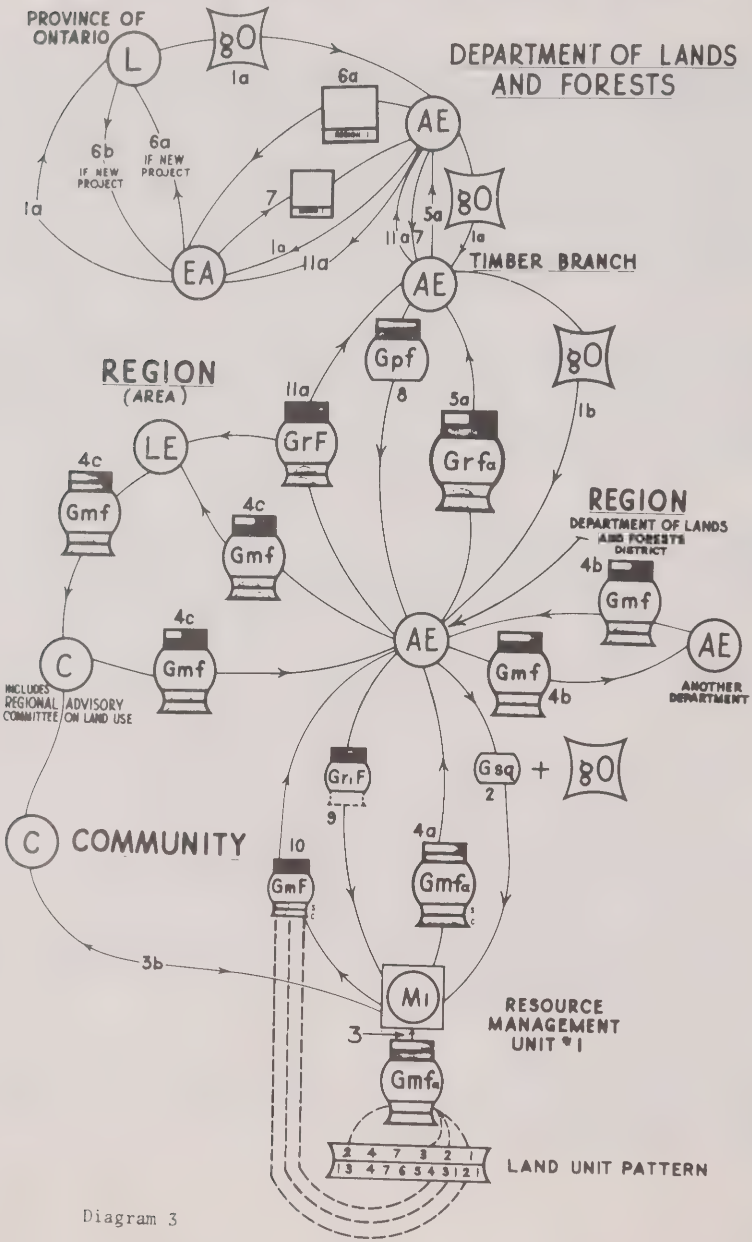
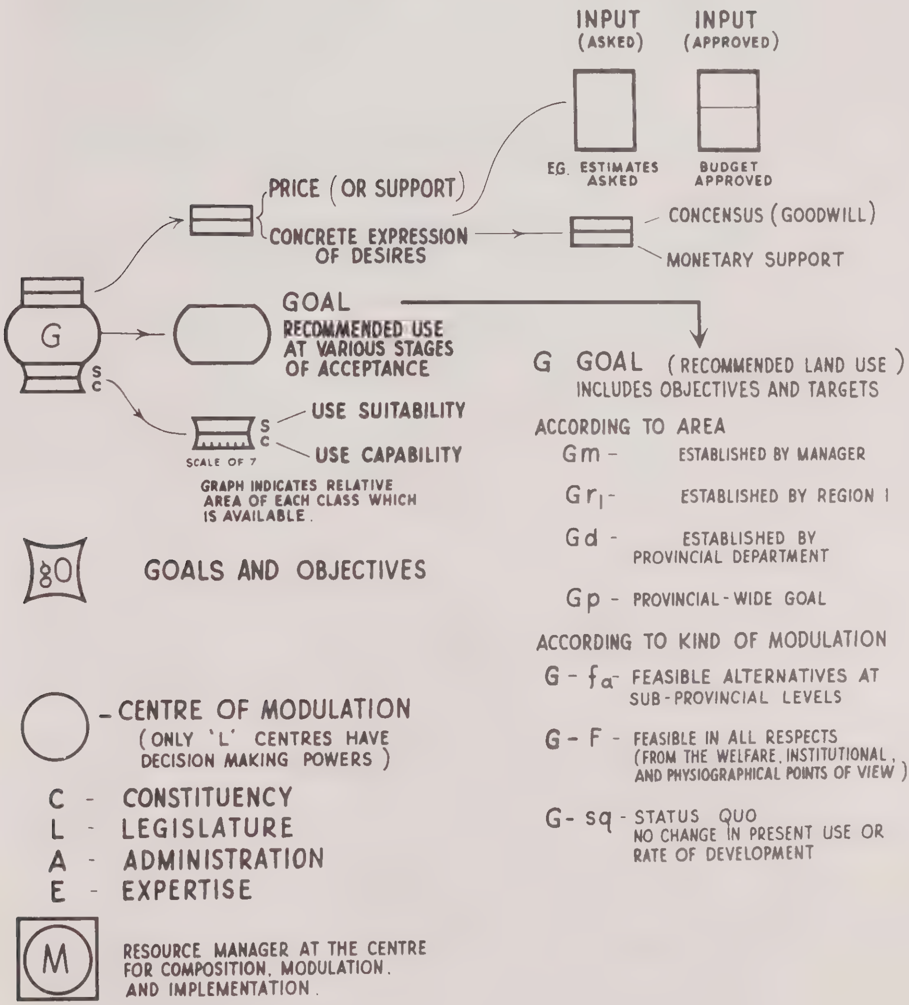


Diagram 3

Diagram 3

KEY TO MODULATION DIAGRAM



The model is that of a process which leads to an areal plan but is not a model of the plan itself. In fact, the plan derived from the modulation processes would be properly classified as a management plan which is a very restricted form of scenario.

Since the final design on the ground will be produced by a resource manager, it is he who should make the initial plan from directives from his administrators who interpret the goals expressed by the Provincial Legislature. The manager must also be a key modulator after his plan has been reviewed and modulated as shown in the diagram.

All the resource management plans developed in this way and all the managers' knowledge of the natural resources are required to build the scenario of the development region of which the resource management unit is a significant part. Thus this description of the modulation process demonstrates the important role which resource managers should play in the development of regional plans.

2.541 The Modulation Diagram. Diagram 3 presents the modulation model in concise form. The key to this model covers most of the explanation required to understand the model. The numbers 1a, 1b, 2, 3, 4c, etc. indicate the order in which messages are passed over the modulation routes. Space does not permit further amplification of processes in this report.

2.542 The Message of Diagram 3. The following are the highlights:

(a) All land-use planning originates with the people of the constituency who initially express their goals through the white papers of legislative bodies.

(b) In planning the management of the primary resources, the design or plan expressing the pattern of change can be made *only* by the resource manager who knows the area to be managed.

Only the manager is able to make an environmental appraisal of the area to determine what are the possible significant changes and where they can be made. He selects those areas which are suitable for, as well as capable of, the specific use he has in mind. He must also determine the feasibility of his proposed use as far as he can determine it. This will be based on cost-benefit analyses not only that of the market place but the benefits and/or costs associated with non-market goods and services. With regard to this latter analysis, the manager is in a good position to determine the opinion of the local community, communication '3b' on the diagram. However, this may be only a part of the total analysis since the local amenity may be enjoyed regionally and possibly provincially.

The determination of feasibility at the local level is indicated by the lower case 'f' to distinguish it from that at the regional level indicated by upper case 'F'.

(c) The plan should not be approved until there is a complete integration of local targets, regional objectives and provincial goals. Since all the above are indicated by the letter 'G' on the communication "bucket" in the diagram, the differentiation as to goal, objective or target must be deduced from the context.

The symbol 'F' (upper case) indicating feasibility at all levels should not be entered into the symbol until the ecology at the local, regional and provincial levels is fully recognized.

(d) The management plan is finally completed by the resource manager. This and other management plans are integrated by the regional resource planner into the regional scenario. From the regional scenarios a provincial plan is made. These operations are not considered in Diagram 3.

(e) The role of the constituency. The constituency refers to the people affected by the implementation of land-use plans whether they are at the local, regional or higher levels. Their role is:
  (i) To initially express a desire which is considered by the expertise and administratives who frame general objectives from which the legislators formulate the goals which then issue to the administration and constituency.
  (ii) To modulate the models proposed by the planners, particularly to indicate the support, either in terms of money or good will, they are willing to provide. Although monetary support is the test of true desires, consensus in the form of sentiment and opinion is very important.

(f) The role of the expertise at levels broader than that of the resource manager is largely one of modulation for a single-purpose type of production on public land.

2.55 Decision Making

The modulation of the alternative scenarios and the selection and final approval of the plan selected are all processes involving decisions. In order that the goals and objectives of a land-use plan may be fully attained, these decisions should be made by all areal sections and by all sectors of the constituency, and should be based on all the types of rationality which can contribute to the planning process.

2.551 Five Types of Rationality. Paul Diesing (1962) in his book, "Reason in Society", has this to say:

> "In many social theories rationality is defined as identical with efficiency. The efficient achievement of a single goal is technical rationality, the maximum achievement of a plurality of goals is economic rationality, and no other types of rationality are admitted. A typical example is provided by von Mises (1960:148) who writes, 'The economic principle is the fundamental principle of rational

action, and not just a particular feature of a certain kind of rational action.....All rational action is therefore an act of economizing.' Similarly, in organization theory the 'rationalizing' of an organization is taken to mean the increase of its productive efficiency. A rational organization is an efficient one, and other principles or modes of organization are thought to be non-rational or irrational.

"Such a conception of rationality limits its scope rather severely. The criterion of efficiency is applicable only to means and not to ends, unless these are in turn means to further ends. Thus ultimate ends, the basic aims of life, cannot be selected or evaluated by rational procedures; they must be dealt with by arbitrary preference, or intuition, or by cultural and biological determinism. And yet it seems unfortunate to have rational procedures available for the relatively less important decisions of life and to have none for dealing with the most important decisions. Nor is this all. Several rather common types of activity can only with great difficulty be assimilated to the category of efficient action and evaluated by standards of efficiency." (Diesing 1962, p. 1)

Diesing proceeds to discuss the five types of rationality placing social, legal and political rationality in a more important position than the traditional and economic rationality.

Space permits only a brief introduction to the five types of rationality. Although technical rationality is part of economic rationality, it will be presented separately.

(a) Technical Rationality is the efficient achievement of a given end. It appears in actions which are undertaken for the sake of achieving a given end.

"The kind of good achieved by technical rationality, both substantial and functional, may be called utility or satisfaction of desire, or goal achievement. When a person effectively adapts means to an end, he achieves the end and his desire is satisfied. Anything that anyone wants is a good that can be gotten from a technique providing the goal is operationally specific and the necessary means are available and can be made the object of technical rationality." (Diesing 1962)

Further definition is found on page 236:

"First, the efficiency of which Mannheim wrote is an order of production. Raw materials enter the system, move along channels in which they are processed, and leave the system as products. The parts of the system are specialized, each one performing one task in the series of receiving, storing, moving, processing, and exporting (out of the system). The operations are designed to avoid waste, that is, to achieve a maximum transformation of

materials and operating parts into product. This is an impersonal sort of order which can occur both in human and nonhuman materials. It occurs in machines, factories, hospitals, schools, one's daily schedule, living quarters, planned cities, entertainment, religious exercises.

"The order of production is an abstraction which cannot exist apart from the order of value measurement. Its objective is to transform available resources into maximum product; but 'maximum' here means not maximum quantity but maximum value, and maximum value is indeterminate apart from some way of measuring value. Only after the economic problems of pricing and valuation have been in principle solved does it make sense to talk about a problem of production."

(b) Economic Rationality. The institutional setting for economic rationality is obviously the economy, i.e., that part of society's institutions devoted to the production, exchange and distribution of commodities. It takes in raw materials, transforms them into a variety of finished products and distributes the products to points of consumption. The economy is an open system with reference to both inputs and outputs.

"Then there is economic order, an order of measurement and comparison of values. It includes media of measurement--money, time, calories--and values or commodities which are measured by them. Each commodity has a number assigned to it which states its exchange or comparative value and gives it a rank in an order of values. Individuals can construct their own rankings, using the common media of measurement; and the discrepancy among individual rankings leads to exchange." (Diesing 1962, p. 236)

(c) Social Rationality is that decision or action which produces goods through those transactions of a social nature between the individuals comprising a human ecosystem.

According to Diesing, such social systems (ecosystems) are "built up, sustained and adapted to changing continua by a continuous unconscious integrative process. This process consists of the adjustment or mutual modification of forces." This is virtually the transaction process previously described as a characteristic of the human ecosystem.

"Social rationality is an order of interdependence or solidarity. It exists when people engage in joint action, when they share experiences and understand one another. People who constantly share action and experience are interdependent in the sense that a change in one produces an answering change in others; they are constantly adjusting to one another - constantly changing. The parts of an interdependent system fit together and complete each other. Conflict and disjunction are both absent since each would destroy mutuality. In addition the people involved in such a system must each have the same cognitive map of the system, since divergences in maps would lead to

conflict or separation in action. Because of the identity of the cognitive map, each action by a part of the system is understood and appreciated by the other parts; it is accepted, supported, and carried to completion. The persons participating in shared action develop both trust and self-assurance because of their mutual support.

"An order of interdependence develops through the mutual adjustment of parts; it is not focused on any external product, as is a productive order. Its parts are internally related in contrast to the external ranking relations occurring in an economic order. But the fact that abstract distinctions can be made among the kinds of order does not imply that they are mutually exclusive in reality. A concrete system can exhibit an order both of production and of interdependence, if the parts are adjusted both to each other's expectations and to the requirements of a productive process. It may be difficult to satisfy both requirements together since they frequently conflict, but it is certainly possible in principle." (Diesing 1962, p. 236)

(d) Legal Rationality.

"The legal order is an order of availability. It determines what resources are available to each legal person, what persons each can count on to perform which actions, what actions each person must perform. Orderliness here consists of a clear and exact assignment of each resource and action to some specific person or persons, and of an exact match between the acts one person expects and the acts other persons are required to perform. When there is no confusion about what each person can do and what he must do, there is legal order." (Diesing 1962, p. 237)

(e) Political Rationality.

"Finally, there is an order of discussion and decision. Information of various sorts enters the system; it is interpreted, both for its factual implications and for normative connotations; the interpretations give rise to suggestions for action; these suggestions are modified, combined, tested, and narrowed to two or three alternatives; and there is a final choice or compromise. In addition to this more or less temporal sequence, there are provisions for checking and correcting at all stages. Factual reports are checked against observations from different standpoints; inferences are checked against new observations and against counter-inferences; action suggestions are modified by counter-suggestions. The system is rational if there is adequate provision for inventing and checking suggestions, and adequate procedures for combining suggestions into a decision. 'Adequacy' here means effectiveness in dealing with the problems facing the system." (Diesing 1962, p. 237)

It is clear from his book that Diesing would consider consensus of the constituency of greatest value in the entire planning process. Important as

technological and economic rationality are, social and legal rationality are needed to provide the organization which enables the political rationality of the entire community to produce the greatest good.

For a discussion of the application of rationalities other than that of economics to land-use planning, see "The Process of Making Good Decisions About the Use of the Environment of Man" by Hamill (1968).

2.6 PHASES OF THE PLANNING PROCESS

In order to demonstrate the application of many of the preceding concepts and principles to actual planning, the steps which should be taken in the planning process are outlined below. These steps should be effected by a planning team consisting of specialists in various disciplines directed by a planning chief.

2.61 Phase 1

Complete a general overview for the land area for which the development of a plan is proposed. What are the general physical, political, social and historic characteristics of the region as a whole? Where is the region situated in relation to centres of population, markets, transportation routes (land and water), and other economic factors?

This phase is concerned with the preliminary development of a regional "scenario".

2.62 Phase 2

Establish clearly the planning level--the person or group of persons for which the plan is being developed. For which type of community or level of government is the plan being prepared? Is a plan being developed for a local municipality, a county, a regional government? Is a program of action for a megalopolis, a province or for the nation being considered? Does the group for which the plan is being prepared have the authority to implement the plan, or is it primarily an advisory body?

A framework of 'levels of implementation' helps to sort out where the decisions to be made at the various administrative levels fit into the goals to be expressed in the plan. For example, in highway location and construction the planner must be aware at all times of the impact of his decisions on the decisions that are taking place in the surrounding districts. The *continuity* aspect of highways in space requires coordination of activities at all levels.

2.63 Phase 3

Formulate goals and objectives for the regional "scenario" to serve as guides to planning activities. What are the value systems of the society in the region and in the surrounding regions? The suggestion here is that the manipulation or management of natural resources is not an end in itself; these

activities must have relevance or meaning in relation to the society which they serve[1].

Is the goal solely one of industrial economic expansion? Or are the objectives along the lines suggested by the Prime Minister of Ontario[2], "the provision of the best possible environment for our people, and at the same time, the creation and maintenance of an atmosphere which will encourage economic growth and development throughout the province"?

Does society accept the proposition that sound and effective regional planning must recognize the existence of a limited natural resource base to which both rural and urban development must be properly adjusted in order to insure a pleasant and habitable as well as an efficient environment?[3]

2.64 Phase 4

Survey the existing physical, cultural and social conditions of the area, i.e., determine the basic opportunities, attributes and/or constraints present. The types of summaries that could be undertaken are:

(a) Inventory of the ecological and physical resource base--the data bank for all further investigations and interpretations. This aspect is described in Chapter 6. Existing resource inventory maps, e.g., geological, soils and Canada Land Inventory maps, are also a valuable source of background information.

(b) Inventory of the existing political framework and policies within which the plan will be developed. The structure, activities, legislative authority and area of jurisdiction of the various types of resource management agencies that have an interest in the region should be examined. The authority of all levels of government--federal, provincial and municipal agencies--should be reviewed.

The present situation in many regions of the United States and Canada indicates that it is not lagging technology but rather governmental organization along single resource lines that forms some of the major stumbling blocks in the development of integrated, multi-purpose resource management programs. For example, major problems of metropolitan and regional planning have arisen due to (i) accumulation of independent urban, suburban and rural local governments, and (ii) piling up of overlapping layers of local governments set up for various single-function purposes

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1 See "Towards Integrated Resource Management". Report of the Subcommittee on Multiple Use, National Committee on Forest Land, 1969, for further discussion on this point.

2 Design for Development. Statement by the Prime Minister of the Province of Ontario on Regional Development Policy, April 5, 1966.

3 Bauer, K.W. 1968. The Role of Regional Planning in Resource Conservation. In Soil, Water and Suburbia, Proceedings of Conference sponsored by U.S.D.A. and Dept. H.U.D. June 1967, Washington, D.C.

(e.g., special districts or authorities for schools, sewage disposal, water supply, parks, open-space development, transportation planning, etc.). The territorial jurisdiction of all these various authorities rarely coincides, and it would be safe to say that in some instances a sense of *rivalry* rather than a sense of public *service* is more common.

Clearly one of the major problems in regional planning is to decide which functions will be handled by the various levels of government, in order to effect greater area-wide cooperation in the solution of regional problems. Examples of problems that transcend local municipal boards are water pollution, air pollution, transportation, park and open space preservation.

(c) Inventory of the financial resources that are available to prepare and implement any plan which might develop from the scenario. Existing federal and provincial legislation respecting financial aid should be reviewed to ascertain the assistance that is available to particular communities and regions (ARDA funds, FRED, provincial assistance to municipalities for planning, Ontario Conservation Authority funds for capital expenditures, maintenance, etc.). What type of cost sharing arrangements are possible for land development, capital costs and equipment? This survey of financial resources should include private resources that are available through investment in industry, and in "new town" developments.

(d) Survey and analyze present uses and trends in the area being examined (what kinds and in what amounts). For example, all or some of the following characteristics should be examined depending on the purpose of the plan:

(i) Provincial and regional population distributions and characteristics, e.g., age distribution, income, education, mobility and distribution of the labour force.

(ii) Predominant land uses in rural landscapes and built-up areas (locations of primary, secondary and service industries, agricultural, recreational and forestry land uses with emphasis on land requirements).

(iii) Cultural, historical and educational services, facilities and values.

(iv) Transportation networks, utility and communication facilities.

(v) Available leisure time and disposable income, use of recreational facilities (day use, intermediate and resource-base facilities) and purchase and rental of sporting equipment.

2.65 Phase 5

Integrate compartmentalized surveys and modulations through technological, social, economic and political interests. This is a process of development of preliminary plans of action within the context of the assumptions established for the program in question.

There are two kinds of integration to be made: (i) the basic surveys and compiling of relevant factual data, and (ii) expressions of demands and desires of the constituency.

Since demands and desires can be expressed in meaningful terms only in relation to specific programs, there is required a special type of integration known as modulation. Modulation in land-use planning is the modification of any aspect of a land-use plan in order that it expresses the desired objectives by keeping each part and process of the plan in proper measure or proportion relative to the plan. An example of the way in which technological, social, economic interests modify through modulation the objectives and targets to meet the goals of the politicians is presented in Section 2.54.

Integration is effected through the planning team working in concert with the constituency. The team draws upon its own knowledge and experience and upon that of local authorities such as resource managers and municipal administrators. It makes use of analyses of the total expression of the desires of the constituency. A consensus is then reached through a process of discussion and compromise.

The Principal Steps of Phase 5:

(a) Integrate all pertinent data into draft scenarios or scenarios using the ecological perspectives outlined in Section 2.4. Modulators and decision makers should be provided not only with well-documented and rationalized alternatives but with a background philosophy on which to make choices. A suggested guideline is "Planning for Diversity and Choice" edited by Stanford Anderson (1968).

(b) Sense the acceptability of the scenario or scenarios through public education, public hearings, etc.

(c) Modify scenario or scenarios on the basis of additional inputs obtained from the people who are affected by the major proposals of the scenario or scenarios.

2.66 Phase 6

Implement the plan. This phase can be subdivided into the following aspects of development:

(a) *Pace* of development or TEMPO (this is affected by regional and national trends, not local developments)

(b) Priority of *place* of development or LOCATION

(c) *Pattern* of development of DESIGN

(d) Priority of *time* of development or SEQUENCE

2.67 Phase 7

Follow-up of the implementation of the plan. A survey of the extent to which the action being taken is effective in securing the goals sought. The planning process is a continuing one and the planner or planning team must be part of the phase of re-evaluation.

Chapter 3

THE CLASSIFICATION AND EVALUATION OF LAND FOR BIOLOGICAL AND GEOGRAPHICAL PRODUCTION

3.0 INTRODUCING SITE AND LAND UNITS AS ECOSYSTEMS

Ecosystems were introduced as 'production systems' in Chapter 2. Biotic and human ecosystems were differentiated on the type of relationships considered. The characteristic feature of the biotic ecosystems is the relationship between the plant and animal communities and their non-living environment resulting in biological production. The characteristic feature of the human ecosystems is the relationship between man and his total environment, including that between man and the biotic ecosystems. To reduce conflict of interpretation in biotic and human ecosystem, the term *site* has been used chiefly to connote biotic ecosystems and the term *land* to connote human ecosystems. This cannot be strictly adhered to since a site unit is part of a land unit. Accordingly, 'site classification' is a part of 'land classification'.

In order to describe and classify biotic and human ecosystems systematically and to evaluate these classes on a comparative basis, a method by which all site and land units are interlocked in one comprehensive scheme of classification was developed by the senior author when he was Chief Research Scientist in the Ontario Department of Lands and Forests (Hills 1952, 1958, 1960a, 1960b, 1960c, 1960d, 1961, 1963). A summary of this integrated scheme of classification and evaluation is presented in this chapter together with such modifications and additions which this author has made during his recent land-use research.

3.1 THE NATURE OF HOLISTIC[1] LAND CLASSIFICATION WITH ITS FOUR SPECIFIC INTERLOCKING SYSTEMS

Unfortunately, the term land classification has two connotations, one of which includes the other.

The most comprehensive connotation, namely that of holistic land classification, includes both the processes of classification and of evaluation as applied to both site and land units.

Land classification, in the specific sense, involves processes which identify, describe and name areas in terms of their natural features without attempting to rate them. In contrast, land evaluation consists of a series of ratings, for all types of uses, of the units established by the land classification processes.

Since the term *classification* includes both classification and evaluation and the term *land* includes both land and site, the following are the specific processes which are included under the holistic land classification:

Holistic Land Classification
- (a) Site Classification
- (b) Site Evaluation
- (c) Land Classification
- (d) Land Evaluation

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[1]Holistic from the Greek holos meaning whole.

Diagram 4 indicates graphically the interrelationships between these four interlocking systems. In order to discuss these in the order in which they are established, the various sections of the diagram will be examined in anti-clockwise order.

The units of classification are shown on the upper half of the diagram, the ecologically derived 'site' units on the left, and the geographically derived land units on the right.

The units of evaluation are shown on the lower half of the diagram and at the extreme right, the evaluation of site units in the more central position grading into the evaluation of land units (patterns of site) toward the bottom and right of the diagram.

Site classification, shown in the upper left hand quarter of the diagram, is the subdivision of continental land areas into a hierarchy of site units which progressively decrease in size until the physiographic site phase is reached. The site phase is the ultimate unit which is the basis for site evaluation. However, the broader units are useful in providing the ecological frame of reference for the site phases. The site phases are generally too small in areal extent to be mapped individually on a practical basis. Accordingly, these other units are useful as mapping units to indicate the distribution pattern of the site phases. In addition to the units shown on the diagram, there are other site units such as site classes (useful in describing the characteristics of the site region in a concise and comparative form) and the site districts (useful broad subdivisions of the site region when differences at the meso level are required). Neither of these units are required in the hierarchical scheme of land evaluation.

On the lower half of the diagram, the various processes of site evaluation are shown. There are no 'site evaluation mapping units' indicated since site classification units are used to express the areal occurrence of the evaluation classes or ratings. Neither are the evaluation classes shown because of their great number. There are scales of use-capability classes for each of agriculture, forestry, wildlife, recreation and domestic water supply. Each of these scales may vary according to (a) the number of classes in the scale, (b) the type of crop rated, and (c) the level of management considered. The evaluation scales used in the study area are discussed in detail in Chapter 6.

The ecological site units, particularly the more homogenous ones, provide the physical setting for the ratings of capability and other categories of evaluation. Although the broader site units are also distribution patterns of capability ratings, these patterns are not always the patterns best suited to land-use planning.

Having examined the limitations and facilities of the features of site phases for various types of production, first individually and finally in pattern (see bottom of diagram), we are ready to proceed to land classification, a grouping on geographical rather than upon ecological grounds. It would appear from the diagram that this grouping of site units, known as land classification, can proceed in two diverse ways, namely, directly from site classification and indirectly through site evaluation. The truth is that, as in other ecological procedures,it is necessary to proceed not only from different quarters but 'to make the trip' back and forth several times before the relationships can be established with any degree of finality.

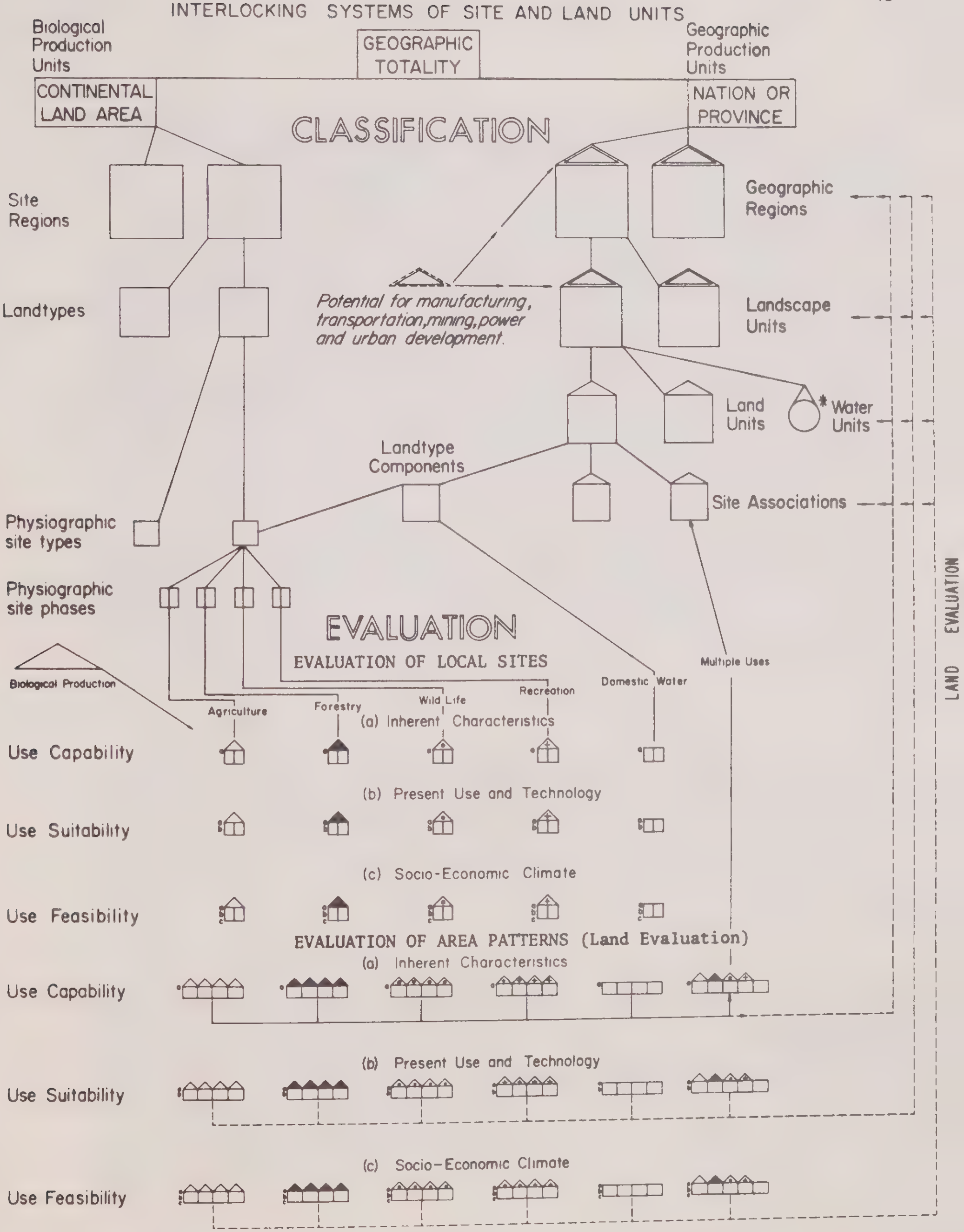

Diagram 4

* *The evaluation of water units follows a pattern similar to that of land units*

In the direct route, the physiographic site types may be grouped to form land units with landtype components as intermediate units. More precise, however, is the integrating method in which site phases (subdivisions of site types) are evaluated first individually and then in patterns in preparation for grouping (integration) to form site associations which have a characteristic multiple-use pattern.

This procedure is shown on the diagram by the solid line on the right side which proceeds from the symbol of multiple-use capability through multiple uses to site association. From here to the top of the page, the succession of integrations known as land classification establishes a hierarchy of units from the site associations to the geographic or multiple-use region (the upper right of the diagram). Each geographic unit is established with due consideration to all the other units in the interlocking systems. Thus geographic regions may be established in the same way that site regions were established, namely, through a recognition of the patterns of the local productivity system, even though these local systems have not been mapped and described in detail. Although site regions do not coincide with geographic regions, the site regions provide a helpful frame of reference for the establishment of geographic regions.

The transition from site evaluation to land evaluation occurs first in the evaluation of the areal pattern at the bottom of the page and continues at the extreme right from bottom to top. Nevertheless, the region and other land units must be established by classification before they are rated by the process of land evaluation. This is another example of the circular procedures required with systems which are circular in both their causality and their resultance. It should be noted that while capability is the aspect of evaluation which is given greatest weight in establishing land classes, feasibility is the final aspect of the land evaluation used in land-use planning.

All of the activities shown on the chart come under 'holistic land classification'. Land classification, in this context, is that activity which subdivides the continuous mantle of the land and water of continental areas into units suitable for (a) describing and evaluating the potential productivity of the natural resources, and (b) planning their development and management.

This has been a brief run-through of the entire complex system. The following discusses the four systems in greater detail.

3.2 SITE CLASSIFICATION

Site classification is that activity which subdivides the continuous mantle of land and water which constitutes the earth's surface into physiographic site units suitable for studying specific relationships between the physiographic environment and the series of biotic communities which it supports. Such relationships constitute the basis for determining land-use alternatives after the site units have been grouped into land units.

Since physiographic site units are established for the purpose of ranking their biological productivity, the soil and climate features which are

most significant in supplying matter and energy for that production are selected as criteria for classifying sites.

In the first paragraph, site classification was introduced as a differentiating process in which broad areas were subdivided into a hierarchy of successively smaller units based on the character of their physiography and the relationship between this physiographic environment and the series of biotic communities which may develop within it. However, this differentiating process proceeds at two or more levels concurrently in order that the units established at one level fit into the units at the level above and/or below them.

Thus site classification is a differentiating and an integrating process at one and the same time. Generally speaking, it is helpful to follow the chart from upper left to middle left and say that site classification is a process beginning with site regions and proceeding until the penultimate physiographic site type and the ultimate site phase is reached. Both of these are small homogenous areas. The site phase and in some cases the site type require no further subdivision.

Naturally physiographic site phases cannot be defined without reference to the site region in which they exist. The converse must also be true that a specific site region cannot be defined without reference to the pattern of physiographic site types which characterize it. The method by which successional changes in the vegetation spectrum, in relation to landform position, have been used to establish site regions is discussed elsewhere (Hills 1960d). Reference may be made to these papers if the following definitions are not sufficient to provide a working knowledge.

3.21 Site Region

This is an area within which similar combinations of relief and parent soil material have similar climate and consequently a similar succession of plant communities. This similarity of succession of plant communities on similar landform features indicates a relatively narrow range of macroclimate, specifically air temperature and air humidity. It follows that if two similar landform areas have received the same type and degree of natural disturbances and human management, the current vegetation type and amount of crop production will be much the same for both areas. Although relatively narrow, the range of macroclimate as indicated by those broad vegetation differences occupies areas ranging, in Ontario, from 1,000 to 40,000 square miles. Most of the smaller regions are only parts of larger regions which extend outside of Ontario (Hills 1960d).

3.211 Differentiation of Site Regions into Landtypes and Physiographic Site Types. Within the boundaries of site regions, regional scales or gradients of features are established to differentiate local areas differing in production potential, the significance of which are specific for each region. One of the most important of these gradients is soil moisture regime which for any region ranges from the driest (for the region) to the wettest (for the region). In some regions the driest is not so dry; in others (a dry region) the wettest is not really 'wet'. Other gradients of importance in site differentiation are soil texture, petrography (mineralogical composition) of soil materials, depth of materials in rooting zone (10+ feet). The use of these gradients within a site

region provides the basis for subdividing the region into physiographic site types which are homogenous with respect to their potential for biological production.

Although the physiographic site type is the basic unit, frequently it is too small to map at a practical scale. Common mapping units within the region and the scale at which they are commonly mapped are:

Land type pattern	-	2 miles to inch
Landtype	-	1 mile to inch
Site association	-	20 chains to inch
Site Phase	-	4 chains to inch.

3.22 Landtype

A landtype is a subdivision of a site region recognized by combinations of a specific aspect from each of the following landform features:
(a) texture of parent soil material;
(b) mineralogical composition of bedrock and parent soil material;
(c) depth of parent soil material.

Landtypes are easily recognized in the field by patterns of the above landform features supporting *distinctive patterns* of plant communities in the various stages of vegetation succession.

The difference between landform and landtype may be summarized as follows. Landform features occur independently of climate. Consequently, the same combination of landform features supports different vegetation succession in different site regions.

Since a given landtype occurs only within a specific site region, landtypes must, of necessity, be defined by adding the macroclimatic features of the site region to the three landform features mentioned above.

3.23 Physiographic Site Types

These are subdivisions of landtypes based on (a) moisture regime, (b) local climate, (c) significant variations in soil depth more specific than those which characterize the landtype.

The use of the various physiographic gradients to attain this level of differentiation results in a relatively homogeneous unit of a small size (i.e., seldom more than 100 acres and sometimes less than five acres).

The physiographic site type is a basic physiographic unit in plant ecology, since the control exercised by this complex of factors results in a narrow and identifiable range in natural vegetation succession and production. Thus, upon each physiographic site type a series of ecosystems develops, according to the natural controls of plant succession and to the human controls of crop production.

3.24 Site Phase

Frequently it is necessary to subdivide physiographic site types into physiographic site phases on differences such as stoniness, steepness of slope and type and depth of peat which are important in the production processes.

A site phase is a subdivision of a physiographic site type according to the requirements for rating a specific type of biological production such as field crops, pasture, forest and wildlife. This differentiation is based on features which influence the cultural practices which will be carried on rather than those which control biological production *per se.*

For example, in the production of tilled crops certain physiographic features of the land, such as steepness of slope or degree of stoniness, and which are not considered at the higher levels of classification, are introduced as agricultural site phases. The soil phases of the soil survey are agricultural site phases, since the ranges of the classes are determined largely with regard to their effect on the production of agricultural crops.

The criteria used for establishing other site phases will be discussed under the specific land use.

3.3 SITE EVALUATION

Site evaluation is a ranking or a rating of the productive capacity of the site units established by site classification. These ratings may be in quantitative or comparative terms.

The natural characteristics of each body of land should be known in order to determine how it can best be managed. Furthermore, the production data (practices and yield) obtained on one area can be applied with confidence to other areas only if it is known that the natural characteristics of the two areas are the same or if their relative position on the gradients of signficant natural features are known and interpolation is possible. *Thus, land must be first classified before it is evaluated. Site classification is a fixing-to-begin process which provides the units of land which are used in site evaluation and in land-use recommendations.*

The following are the types of site (and land) evaluation:

Present Use
Use Capability
Use Suitability
Use Feasibility

In land capability and land suitability, comparisons are made between levels of the same land use on the same area under different management practices or on different areas under the same management practices. At no time do capability and suitability indicate a level of comparison between two uses as feasibility ratings do. For example, it does not follow that a site with a Class 1 forest use capability and a Class 3 agricultural use capability should be allocated to forest use.

The following definitions will indicate the way in which site evaluation may function as one of the interlocking systems of land classification. Further discussion of these phases will be found under:

(a) Perspective E of land-use planning (Section 2. 5)
(b) Appraisal of land for various uses (Chapter 6)
(c) Land evaluation (Section 3.5).

3.31 Present Use

Present use as now conceived falls into two categories.

(a) A description of the present vegetative cover and other features. This concept of present land use is a mere statement of the type of crop which is grown on an area without specifying the level of production nor relating production to the kind and intensity of management and the degree of effort employed. This concept is meaningless in site evaluation unless related to physiographic site type and the type of natural or cultural controls. In this context it becomes a classification merely in terms of inherent characteristics.

(b) A type of site evaluation. For this purpose, present land use is defined as the actual quantity and quality of production on a specific physiographic site having a specific site condition for a specified period under a specific type and intensity of management. It will be clear from an examination of the definitions of capability, suitability and feasibility which follow that this concept of present land use is an essential part of any scheme of land classification, site evaluation and land-use adjustment. (Site condition is the condition of the surface of the ecosystem, particularly with reference to the type and degree of decomposition of the litter, the type and degree of humification of soil organic matter and the physical condition of the upper soil horizons including the 'plow soil'. The tilth of farm soils is included in the concept of site condition.)

3.32 Use Capability

Land-use capability is the potential of an area to produce goods and services of various kinds under specified types and intensities of economic and technological controls. This type of evaluation answers two types of questions.

(a) What is the level of production of a specified crop on a specified land area when that area is developed at stated levels of economic and techno-controls?

(b) What are the kinds and degrees of limitations which prevent any specific land area, chosen at random, from reaching the maximum production established for the region when fully developed relative to specified controls?

The answer to question (a) is an absolute statement regarding a specific area of land. It can be obtained by applying the technological and economic inputs specified and measuring production without reference to any other area. However, greater reliance can be placed on these data by relating them to those obtained from the same area for a number of production periods and to those

obtained from other areas of similar physiography. This determination of production levels for a specific area and for areas of specific types is needed to provide the basis for obtaining answers to question (b).

Question (b) requires that the statement of absolute production for specific areas be placed in a comparative framework. This is obtained through establishing gradients of production which can be used as criteria for the definition of the classes into which the gradients are divided.

In order to establish the needed comparison of opportunity, the scales of outputs must be related to scales of inputs. However, in use capability rating (which is only a preparatory step to feasibility determination) benefit-cost ratios can only be stated in general terms such as bushels of corn per unit of effort.

The assessment of land capability is made in order to compare physiographically-defined areas for any given use. Land capability is, in itself, inadequate and, in fact, misleading as a guide to differentiating between various uses for any given area of land.

3.33 Use Suitability

Use suitability is the relative ability of a specific area in *its present condition* to produce specific goods and services. Two types of references are used to indicate this relative ability to produce.

(a) Absolute levels of production for the same site or sites having the same physiography.

(b) Comparative levels of production for the same land use for different physiographic sites according to use capability and site condition.

As an absolute measure of 'relative' ability for specific areas, use suitability may be viewed as the gap between the production of the site in its present condition and its potential or other 'reference' level of production. In this sense, use suitability may be said to answer the following question: "What is the relative degree of technological effort to convert a specific site, in its present condition, to that needed to obtain a desired level of production?"

On the other hand, comparative ratings of suitability must include the *capability of the land* to produce at the 'potential' level as well as the input required to bring the land up to this potential level. Thus use suitability may be defined in a number of ways:

(a) The capacity of the site in its present condition to respond to specific management practices (kind and degree of effort) for a specific kind and intensity of use (classes may be in absolute or relative terms).

(b) A rating of the capacity of an ecosystem in its present condition to respond to specified kinds and intensities of management practices in order to reach specified types and levels of biological production.

(c) A rating of the capacity of geographic ecosystems in their present condition to respond to specified kinds and intensities of management in order to reach specific types and levels of geographical production.

In contrast to use-capability ratings which apply to all areas having the same potential and identified by physiographic characteristics and hence independent of site condition, use suitability ratings apply only to those areas which have the same site condition within a single capability class.

In order to have a 'standard' benchmark for use suitability, it has been found expedient to accept 'potential' production as indicated for the capability class as the 'desired level' of production. This may not be desirable in some cases because there are circumstances under which a somewhat lower production is acceptable. For example, in some types of integrated (multiple) use it is necessary to establish a level of production for each of two uses, which is lower than the potential for either use in order that an optimum combined production may be obtained.

Thus, these standard suitability ratings must be used with discernment in determining optimum or recommended use. If the optimum use does not require the full development of potential, the 'standard' use suitability rating must be modified accordingly.

Use suitability can be defined as the gap between present and potential production only when potential production is the goal and only when the site is being considered with reference to itself and not with other sites differing in capability and degree of development.

3.34 Use Feasibility

The following are definitions of feasibility at two levels.

(a) Use feasibility at the local ecological level refers to the relative advantage of managing an area for a specific use or uses having regard to both its capability and its suitability for these uses under existing or forecasted socio-economic conditions.

(b) At the regional level, feasibility refers to the relative advantage of alternative changes in land use, having regard to the conservation of the renewable natural resources and to human needs and welfare.

The feasibility type of site evaluation answers the following question: "What is the relative advantage (in terms of input-output ratios) of using a specific area of land for a specific type and intensity of use?"

Feasibility is discussed further under land evaluation (see section 3.51).

3.35 Recommended Land Use

The following are two alternative definitions of recommended use:

Alternative (a): Recommended use is any type and intensity of land use which the decision-makers considered *expedient* for the implementation of a land-use plan.

Alternative (b): Recommended land use is that feasible use which is selected by a governing body to be in the best interests of the community (municipal, provincial, federal) i.e. the *optimum* use

Recommended use evaluation should answer the following question: "Which one of the alternative feasible uses will meet the desires of the constituency, considering (a) the capability of the land, (b) the suitability of the present productivity system, (c) the relative welfare advantage of the proposed land use (either present or proposed) and (d) the financial, technological and managerial ability of the constituency?"

Recommended land use is that use which is recommended by the agency which prepares, approves and implements a land-use plan. These decision-makers must recognize what is technically optimum and also must discern what is politically expedient.

Thus it would be possible that a 'recommended use' does not meet the above standard if none of the alternative feasible uses put forward meets the needs of the constituency.

3.4 LAND CLASSIFICATION

This is the specific system of land classification which deals with the classification of human ecosystems based on their natural characteristics and not on their rating or ranking, which is land evaluation. Nor is this the holistic land classification which deals with the four specific systems (see section 3.1).

Land classification may be viewed as both a differentiating and integrating process. As a differentiating activity, it is the subdividing of continental areas into multiple-use regions which in turn are divided into landscape units (and sub-units). Landscape units are broken into land units (and sub-units) and these into site associations. This approach has been found helpful to geographers and other regional specialists who are not familiar with the basic details of an area. As an integrating activity, land classification is the grouping of site phases (established by site classification and evaluation) first into site associations and further groupings into land units, landscape units and multiple-use regions.

3.41 Site Associations

3.411 Definition and Function. A site association is a local grouping of physiographic site phases which are so intimately associated that as a unit they exert a combined effect upon biological production and/or some phase of geographic production. A site association may be an association of either land or water sites.

The above definition includes the concept of the landtype component but is more comprehensive than it, in that the site phases in an association may represent two or more landtypes. The landtype component has been restricted to segments of a single landtype.

Site associations including landtype components are the connecting link between site classification, land classification and land evaluation.

3.412 Size of Site Associations. The minimum size of a site association may approximate that of a site phase. Commonly, individual patterns, which have all the representative site phases, range in size up to 10 acres. A recurring pattern of such individual patterns may occupy broad areas of many acres.

3.413 Criteria Used to Establish and Classify Site Associations. The criteria are numerous and varied. In general, they may be divided into two main groups, namely, (a) the ecological, and (b) the geographical.

The ecological criteria correspond to those which are used to establish site units. At this local level these ecological criteria have greater significance in management planning and practice than do those of the higher categories. Accordingly, the line between ecological and geographical criteria appears quite arbitrary at this point.

Ecological criteria may be illustrated by the broad slope-drainage classes used to establish landtype components such as dry-ridge moist-slope and wet flats. The materials within each class may be those of one or more landtypes. In the latter case, the unit is a site association, not a landtype component.

The geographic criteria are those which influence production methods and operations. Accordingly, the criteria vary with the kind of general use which is being considered. In the case of farm production, the criteria consist of those limitations which either prohibit the application of the standard type of management on the area as a whole or render it more difficult to attain. In this category is an intimate pattern of marsh and shallow water and well drained loam. The criteria may consist of patterns which increase the production. For wildlife production, the marsh and loam pattern mentioned above enhances rather than limits production.

3.414 Boundaries of Site Associations. In the cases where the ecological criteria are dominant, the drawing of boundaries is simple, such as the separation of wet flats from moist slopes. However, a consideration of the prospective use of the slopes and the flats might suggest that a further consideration is required. For instance, it may be that the forest production on the less wet fringe of the flat is closer to that of the slope than to that of the remainder of the flats. In this case, the boundary should be placed within the flats. If, on the other hand, the production of the lower wet slopes is closer to that of the flats, the boundary should be placed up the slope.

In any case, the boundary should be placed to include in each unit all the pieces (tesseras) which fit in with the management of that pattern better than they do with that of the adjoining patterns.

3.42 Landtype Component

A landtype component is a site association developed exclusively on a single landtype. It is defined as one or more physiographic site types forming a convenient pattern for land management at the local level although a single site type is not strictly a pattern. Such a homogenous area may happen to be the most suitable subdivision of the area for management purposes. Thus, a landtype component is not a taxonomic unit but merely one of convenience for mapping, describing or managing an area which is large enough for management considerations.

3.43 Land Units

Land units were initially introduced as landtype landscapes (Hills 1963).

3.431 Definition and Function. Land units are patterns of site types, dominantly terrestrial, which may be conveniently described and rated for various uses at a broad level of management. From the viewpoint of differentiation, land units are subdivisions of landscape units based on differentiating physiographic features which are significant in biological production. Land units are designed to provide convenient units for the evaluation and management of forest and agricultural resources at a broad community level. Land units are also very helpful in rating those phases of recreational and wildlife uses which require subdivisions of land within the total landscape unit.

For greatest convenience, land units should be as homogenous as it is possible for a pattern of site types to be. If relative homogeneity of physiographic features cannot be achieved within the prescribed areas, homogeneity or uniformity of resource management or practice is sought. For example, a pattern of heterogenous physiographic sites may provide the land base for a single forest economy.

Disparted Land Units. Most land units form a single land area. However, there are some units in the vicinity of water bodies which must be considered as disparted land units. The various parts of a disparted unit may be (a) groups of islands, (b) two or more areas of land separated on the mainland of a water body, (c) a combination of islands and one or more portions of the adjoining mainland.

A disparted land unit is therefore one which is comprised of two or more areas of land (sometimes up to several thousand) which though separated (disparted) by water bodies have characteristics in common which make it convenient to describe and rate them as a single unit.

Escarpment Land Units. These are separated from the common land units because of significant differences in relief patterns. Escarpment land units are areas consisting of the steep faces and lower slopes of escarpments or similar steep-sided landforms together with adjacent elevated flats. These rims of elevated flats are included with the escarpment for several reasons. The land on the rim of the escarpment usually has a local climate which differs from the rest of the adjoining plains and valleys. There may be a different internal drainage pattern. The prospective use of these fringes are also different. Since the change in environment from outer edge to the general conditions of the upper plain is gradual, the boundary between the escarpment land unit and its

neighbour on the upper plain may be arbitrary. As a general rule, it is considered to be 0.3 miles from the escarpment edge. However, where the escarpment is near a large body of water it is usually convenient to use a common boundary for both escarpment and shoreland unit. For example, the shoreland boundary of the escarpment units of Manitoulin Island bordering on the North Channel are located one mile from the water's edge unless this gives less than 0.3 miles of upper fringe. In the latter case, the shoreland boundary is usually extended to provide for the 0.3 mile strip.

Organic Land Unit. Large areas dominated by organic soils are placed in land units designated P on maps and which, because of their nature, are in the very weakly broken category. Areas of greater brokenness of relief may consist of patterns of small areas of smooth relief and dominated by organic soils. Since these smooth areas of organic materials are subordinate to the more broken areas of mineral materials, they are included with the latter in units having the designation of the latter. However, if the areas of organic material constitute a significant proportion, these components are recognized in the symbol by the addition of P following the number designating the character of the mineral material. For example, land unit mapped as 35P-1[1] is a weakly broken area of deep and shallow loam over bedrock with a significant proportion of organic soils. The maximum percentage of organic soils which is included in the regular land units without recognition in the symbol has not been defined. When the percentage is over 20 percent, the P is usually inserted in the symbol unless the distribution pattern and depth of the organic materials is such that their recognition is of minor significance.

3.432 Size of Land Units. Generally, land units should be at least four square miles so that they may be readily observed and clearly identified on maps of a scale of 1:250,000. To accommodate mapping of areas which are extremely different from the areas which adjoin them, land units of 1 to 4 square miles may be indicated on maps of the above scale. However, the use of units of this size should be restricted since it would be impractical to show more than three or four of these units in any one cluster within a landscape unit. Although units of 1 to 4 square miles could be more easily shown on maps of a scale of 1:50,000, a consistent mapping at this level of detail would require a different site classification which is suitable to this level, a more intensive and systematic study of the area on the ground, and a change in objectives from serving broad, extensive planning and management to one of serving local intensive planning.

3.433 Criteria for Classifying Land Units. Land units are differentiated from one another on the basis of differences of a physiographic feature or a group of features which are considered to have a significant effect upon the potential productivity of the land. The status of a land unit as a subdivision of a landscape unit confers a size limitation upon the land unit. Because of the minimum size limitation, a land unit usually has a greater variation of physiographic site features than the variation of these features within a single physiographic site type. Thus, land units are usually patterns of the basic physiographic site types. Recurring patterns of physiographic site types which determine the overall productivity of the land unit are recognized and provide the basis for separating one land unit from another. However, in complex areas, because of the limitations imposed by the scale of mapping, two or more widely

[1] See section 3.435 for discussion of map symbols.

differing landtypes may have to be included within a land unit. Thus a land unit is an area of land in which one or more patterns of one or more physiographic site types are repeated one or more times.

3.434 Boundaries of Land Units. As indicated above, boundaries of land units are drawn so that the units will be as homogenous as possible with respect to the potential of physiographic features which control biological productivity for biological and geographic production.

Lake and shorelines of rivers which are wide enough to appear as a double line on the 1:250,000 maps may serve as part of the boundaries of the regular non-parted land units. Similarly, with each part of the disparted unit, the boundary of that part terminates at the edge of the body of water which necessitates the grouping. As with other land units, the disparted unit does include the smaller bodies of water which are entirely enclosed by the land. The type of lines used on the map to indicate the boundaries of both the non-parted and disparted land units is shown on Map 3 (Section 4.3).

3.435 Mapping Designation of Land Units. The numbering system developed for designating land units from 1 to 100 is presented in Table 1. Three of their many features are used to inventory land units and to designate them on maps. These are as follows:

(a) meso-relief
(b) patterns of textural classes
(c) patterns of depth over bedrock.

Meso-relief Classes of the Land Unit. The initial subdivision of land into subunits is based on meso-relief. This level of relief refers generally to areas of one mile or greater if the pattern of relief remains relatively the same. Consideration is sometimes given to areas one-half mile by one mile if these are significantly different. The characteristics of the defined classes must apply to at least 80 percent of the area.

The characteristic used for this classification is brokenness or amplitude of relief, measured in feet from the highest common level to the lowest common level.

Very Weakly Broken. The characteristic difference is ten feet. The common slopes are less than 2 percent, so that typical areas have numerous low crests.

Weakly Broken. The characteristic difference is from ten to one hundred feet. The common slopes are 8 percent. A standard of maximum relief in this class is one in which there are approximately sixteen 'knobs' per square mile, each with an 8 percent slope.

Moderately Broken. The characteristic amplitude of relief varies from one hundred to three hundred feet with common slopes up to 25 percent.

One standard of maximum relief for this class is one in which there are approximately sixteen 'peaks' up to three hundred feet per square mile.

Table 1

THE NUMBERED SYMBOL OF LAND UNITS

Example of Numbers 0 - 100

Number designating class of Land Unit according to a Provincial Scale of Landform Classes.(1) — 62 - 12 — Number designating specific area included in the designated class of Land Unit.

62 - 12 refers to a specific area (12) which belongs to Land Unit Class No. 62.

Disparted Land Units

14-d3 refers to a number of class 14 areas which are separated (disparted) by water and collectively designated d3.

BROAD LANDFORM CLASSES (1)

VERY WEAKLY BROKEN PLAINS (2)

Unconsolidated Material	Unit Number
Peat and muck	P(3)
Sand	1
Loam	2
Silt	3
Clay	4
All inorganic materials	5

WEAKLY BROKEN PLAINS (2)

Consolidated Inorganic Material (Bare Bedrock) (3)	Unit Number
Weakly resistant limestone bedrock	6
Weakly resistant argillaceous bedrock	7
Weakly resistant sandstone bedrock	8
Moderately resistant bedrock	9
Strongly resistant bedrock	10

Unconsolidated Inorganic Material (3)	Unit Number			
	Bare and Shallow	Shallow (with bare and some deep)	Deep and Shallow (with some bare)	Deep
Sand (coarse and medium)	11	21	31	41
Sand (fine and silty)	12	22	32	42
Sand (coarse to fine and silty)	13	23	33	43
Sand, with other materials	14	24	34	44
Loam	15	25	35	45
Loam, with other materials	16	26	36	46
Silt	17	27	37	47
Silt, with other materials	18	28	38	48
Clay	19	29	39	49
Clay, with other materials	20	30	40	50

MODERATELY BROKEN UPLANDS (2)

Unconsolidated Inorganic Material (2)	Unit Number			
	Bare and Shallow	Shallow (with bare and some deep)	Deep and Shallow (with some bare)	Deep
Sand (coarse and medium)	51	61	71	81
Sand (fine and silty)	52	62	72	82
Sand (coarse to fine and silty)	53	63	73	83
Sand, with other materials	54	64	74	84
Loam	55	65	75	85
Loam, with other materials	56	66	76	86
Silt	57	67	77	87
Silt, with other materials	58	68	78	88
Clay	59	69	79	89
Clay, with other materials	60	70	80	90

Consolidated Inorganic Material (Bare Bedrock) (3)	Unit Number
Weakly resistant limestone bedrock	91
Weakly resistant argillaceous bedrock	92
Weakly resistant sandstone bedrock	93
Moderately resistant bedrock	94
Strongly resistant bedrock	95

STRONGLY BROKEN UPLANDS (2)

Inorganic Material (3)	Unit Number
All unconsolidated materials, deep	96
All unconsolidated materials, deep to bare bedrock	97
Bare Bedrock and shallow unconsolidated materials	98

VERY STRONGLY BROKEN LAND (2)

Inorganic Material (3)	Unit Number
All inorganic materials	99

Footnote

(1) Landform is land which is differentiated upon the character of (i) the relief and (ii) the nature of the bedrock and unconsolidated materials which give substance to the surface relief. Landform classes apply to all site regions.

(2) Brokenness of land refers to the degree and frequency to which the over-all level of the land surface is broken by local irregularities. The five classes of relative brokenness have been established to provide groupings of slope patterns of significance in land use. Patterns of surface drainage and local climates are examples of the significant features to be derived from these classes.

(3) Organic Landform Classes. To indicate classes in which organic materials occupy an abnormal proportion of an area, the letter P is added to the numeral symbol. The limits of normal proportion of organic soils are set by site regions.

Strongly broken. The characteristic amplitude of relief ranges from three hundred to three thousand feet with slopes over 25 per cent occurring commonly.

Disparted land units are indicated by placing a 'd' between the first number and the last, e.g., 14d-1.

Organic land units are indicated by placing 'P' between the first number and the last, e.g., 35P-1.

Escarpment land units are indicated by placing an 'E' between the first number and the last, e.g., 97E-1.

3.44 Water Units

3.441 Definition of Water Units. A water unit is an area of water of at least four square miles in extent having a pattern of physiographic sites which provides a convenient unit for use-considerations such as fisheries and water-based recreation.

A water unit may or may not coincide with a water body such as a lake or a river or a system of rivers and lakes. A water unit will coincide with a water body only if there are no major differences in use potential from one portion to another. For example, Loughborough Lake in Frontenac County is divided into two water units - the western portion is a shallow calcitrophic water unit, the eastern is a deeper oligotrophic unit.

A water unit may also be a complex of water bodies such as a series of small lakes connected by a river or creek, if these have a common potential productivity pattern.

A water unit is not exclusively water. It comprises all islands less than four square miles within it. It may also include narrow peninsulas which extend into the lake and are largely influenced by it. Conversely, water bodies less than four square miles are part of the land unit in which they are located.

3.442 Size of Water Units. Generally, water units should be at least four square miles so that they can readily be observed and clearly identified on maps of a scale of 1:250,000. Exceptions to this rule are the same as for the land unit and have been discussed under that heading.

3.443 Criteria Used in Classifying Water Units. Water units are differentiated from one another on the basis of differences in patterns of a physiographic feature which is considered to have a significant effect upon the potential productivity of the water. As with terrestrial areas, the physiography includes both the form (morphometry) of the body and its associated local climate.

The morphometric features which are used to designate water units include the main significant features. These are (a) size of the whole water body, (b) the distribution pattern of the various 'stretches' of open water (i.e., fetch patterns), (c) the irregularity of the shoreline, and (d) the percentage

of the water body occupied by islands. The depth pattern based on significant depth classes is a feature not included in the designation but one which would separate a unit from its neighbour. Two other features which may be used are the chemical nature and temperature of the lake waters. As with the land units, water units may be established on any feature considered to be of significance in biological production.

3.444 Boundaries of Water Units. The boundaries of a single water body is the water line shown on the map. When a water body is divided into two or more water units, the boundary shown on the map is more or less an arbitrary one, often representing the location of a transition zone rather than a definite line of demarcation.

3.445 Mapping Designation of Water Units. The numbering system developed for designating water units from 100 to 1000 is presented in Table 2.

3.45 Landscape Units

3.451 Definition and Function. Landscape units may be defined from several viewpoints, each of which clarifies the concept.

A landscape unit is a broad pattern of land and/or water units which constitutes a geographic developmental complex in which the transactions between the component parts are mutually beneficial.

A landscape unit is a subdivision of the land and water areas of a region which is suitable for the planning and management of the renewable natural resources at a community or management unit level. These units must, therefore, be broad units of convenience for evaluating the productive capacity of an area for forestry, agriculture, wildlife, recreation and water production.

A landscape unit is a grouping of site phases on broad physiographic criteria to provide a convenient base for (a) the evaluation of *biological* and *geographic production* under various types and levels of social and economic controls and (b) resource management and regional development.

3.452 Size of Landscape Units. Landscape units must be not less than sixteen square miles for the following reasons:

(a) They are designed to be shown on maps of 1:250,000 scale.
(b) They must be large enough to support a farm or other community based on renewable natural resources.

Units of the minimum of sixteen square miles should be the exception rather than the rule since it would be difficult to show more than three or four units of this size in a cluster on a map because space outside the unit is generally required for the symbols.

3.453 Criteria Used in Classifying Landscape Units. Landscape units are differentiated from one another on the basis of differences in land and water patterns. Variability in the broad physiographic features of climate, relief, soil texture, petrography, and soil depth to bedrock are the criteria applied to

Table 2

THE NUMBERED SYMBOL OF WATER UNITS

Example of Numbers 100 - 2000

Number designating class of Water Unit according to a Provincial Scale of Physiographic Classes. — 162 - 12 — Number designating specific area included in the designated class of Water Unit

MORPHOMETRIC CLASSES

A. For all digits except the unit digits (see insulosity)

C L A S S E S O F O P E N W A T E R /1

TYPE OF CHARACTERISTIC WATER BODY /3	FULLY RESTRICTED — Irregularity of Shoreline /2					GREATLY RESTRICTED — Irregularity of Shoreline /2					RELATIVELY RESTRICTED — Irregularity of Shoreline /2					SLIGHTLY OPEN — Irregularity of Shoreline /2				
	A	R	S	M	V	A	R	S	M	V	A	R	S	M	V	A	R	S	M	V
Large Rivers	-	-	10*	11*	12*	-	-	13*	14*	15*	-	-	16*	17*	18*	-	-	19*	20*	21*
Relatively Small Lakes	-	-	22*	23*	24*	-	-	25*	26*	27*	Not applicable					Not applicable				
Moderately Large Lakes	-	-	28*	29*	30*	-	-	31*	32*	33*	-	-	34*	35*	36*	Not applicable				
Large Lakes	-	-	37*	38*	39*	-	-	40*	41*	42*	-	-	43*	44*	45*	-	-	46*	47*	48*
Very Large Lakes	49*	50*	51*	52*	53*	54*	55*	56*	57*	58*	59*	60*	61*	62*	63*	64*	65*	66*	67*	68*
Great Lakes	79*	80*	81*	82*	83*	84*	85*	86*	87*	88*	89*	90*	91*	92*	93*	94*	95*	96*	97*	98*
Marine Estuaries	129*	130*	131*	132*	133*	134*	135*	136*	137*	138*	139*	140*	141*	142*	143*	144*	145*	146*	147*	148*
Seas and Marine Bays	164*	165*	166*	167*	168*	169*	170*	171*	172*	173*	174*	175*	176*	177*	178*	179*	180*	181*	182*	183*

TYPE OF CHARACTERISTIC WATER BODY /3	MODERATELY OPEN — Irregularity of Shoreline /2					OPEN — Irregularity of Shoreline /2					VERY OPEN — Irregularity of Shoreline /2				
	A	R	S	M	V	A	R	S	M	V	A	R	S	M	V
Large Rivers	114*	115*	116*	117*	118*	119*	120*	121*	122*	123*	124*	125*	126*	127*	128*
Relatively Small Lakes	Not applicable					Not applicable					Not applicable				
Moderately Large Lakes	Not applicable					Not applicable					Not applicable				
Large Lakes	Not applicable					Not applicable					Not applicable				
Very Large Lakes	69*	70*	71*	72*	73*	74*	75*	76*	77*	78*	Not applicable				
Great Lakes	99*	100*	101*	102*	103*	104*	105*	106*	107*	108*	109*	110*	111*	112*	113*
Marine Estuaries	149*	150*	151*	152*	153*	154*	155*	156*	157*	158*	159*	160*	161*	162*	163*
Seas and Marine Bays	184*	185*	186*	187*	188*	189*	190*	191*	192*	193*	194*	195*	196*	197*	198*

* Key to unit digits presented below.

/1 Open Water Landscape Patterns defined below.

/2 Classes of Irregularity of Shoreline within landscape units:

A = Absent; R = Regular; S = Slightly irregular; M = Moderately irregular; V = Very irregular.

/3 LAKE AREA CLASSES

Class	Area
A Absolutely small	Less than 25 sq. ft.
E Extremely small	Less than 5 acres
S Small	5 acres to 640 acres
R Relatively small	1 sq. mi. to 16 sq. mi.
M Moderately large	16 sq. mi. to 50 sq. mi.
L Large	50 to 450 sq. mi.
V Very large	450 to 5,000 sq. mi.
Great	Over 5,000 sq. mi.

CLASSES OF OPEN WATER

Class	Length of Dominant Fetch	Length of Subdominant Fetch
F Fully restricted	Less than 2 miles	
G Greatly restricted	2 to 4 miles	
R Relatively restricted	4 to 7 miles	
S Slightly open	4 to 7 miles	7 to 50 miles
M Moderately open	7 to 50 miles	
O Open	7 to 50 miles	over 50 miles
V Very open	Over 50 miles	

INSULOSITY

B - For Unit Digits

Unit Number	Percentage of Water Body Occupied	Dominant Size of Islands
0	Less than .1	Variable
1	.1 to 3	Variable
2	3 to 10	Large
3	3 to 10	Small
4	10 to 20	Large
5	10 to 20	Small
6	20 to 40	Large
7	20 to 40	Small
8	40 and over	Large
9	40 and over	Small

the land portions of the unit. Variability in size, depth and irregularity of shoreline are those applied to the water portions of the unit.

Ideally, each landscape unit is comprised of a pattern which recurs throughout it in a consistent manner. Since all the surface area of the province must be divided into landscape units, there are areas of less than sixteen square miles which must be included with adjoining areas, even though they are not components of the recurring pattern. However, if the difference is extremely significant, it may be deemed desirable to establish landscape units less than sixteen square miles, even as small as four square miles in cases of unique features. Usually, however, these distinctive areas can be more adequately considered as a subunit of a larger landscape unit. For example, a small lake of six square miles with sandy beaches and backlands within a broad clay plain with a high potential for agriculture could be rated as a landscape subunit as readily as a landscape unit. Considering it as part of the larger unit would also facilitate the rating and planning of that part of the clay plain, the use of which is modified by its proximity to the lake.

Thus, homogeneity of physical features is not a prime requisite for establishing landscape units. On the contrary, that kind of heterogeneity of physical features which provides a potential for a land-use pattern which is distinctive from the pattern of uses of adjacent landscape units is the criterion for differentiating landscape units.

3.454 Boundaries of Landscape Units. Although landscape units are not necessarily homogenous in themselves, they may be composed of several, relatively homogenous areas. In so far as the other criteria which determine the location of landscape unit boundaries permit, these boundaries are drawn so that the full extent of homogenous land and water areas is placed in one landscape unit. For example, lakes of moderate to small size should not be placed in more than one landscape. This means that the dry-beach and back-shore areas around the lake must also be placed within the landscape unit for recreational land use, the lake, its dry-beach and its back-shore constitute the unit which is evaluated. Similarly, the partitioning of wetland and shoreland areas by landscape unit boundaries is to be avoided as much as possible.

3.455 Mapping Designation of Landscape Units. Landscape units are identified using place names, township names or lake and river names. In the case of the latter two, the designations 'river' and 'lake' are *not* appended. For example, the Go Home Landscape Unit is not merely Go Home Lake but includes the land units around it. Actually, Go Home Lake and its shoreland units are but a small subunit of the total landscape unit.

Landscape Subunits. These are associations of land and/or water sites which are generally larger than site associations and are established with particular reference to activities of human rather than biological communities. They are particularly useful units in evaluating recreational land.

Shoreland Unit. The shoreland subunit (shortened to 'shoreland unit' for convenience) is an area which is part of both a water unit and a land unit. It includes both the dry beach and the wet beach to the line marking the five-foot depth at low water. It also includes the backshore and backland portion of the land unit.

3.46 Geographic Regions

A geographic region is an area of considerable size which is set apart from surrounding areas to meet the specific objective of geographic analysis. Because of the diversity of the natural and human resources of Ontario, it is necessary that the province be subdivided into geographic regions at two planning levels, namely, the geographic development region and the geographic planning region.

The relationship between development regions and planning regions is parallel to that between land units and landscape units. The development regions are the relatively homogenous blocks of which the heterogenous planning regions are comprised. Because one type of development region, namely, the multiple-use region, follows more closely upon the concept of landscape units, it will be discussed first.

3.461 Multiple-Use Region. A region is an area of considerable size which is set apart from surrounding areas to meet a specific objective. The objective of establishing multiple-use regions is to group landscape units into broad areas having a common pattern of feasible multiple use (Hills 1950b).

For many parts of Ontario, particularly in the north, the multiple-use region is essentially a high-ranking resource management unit of the Ontario Government based almost entirely on the primary industries. The homogeneity of these areas is based on the type of land patterns which determine biological production. These areas provide a framework for determining feasible levels of primary production such as that of agriculture, timber, recreation, fisheries, etc. The function of a multiple-use region as a development region will be discussed later. If there are significantly large areas of secondary, tertiary and quaternary production included in the site multiple-use region, these are considered not as part of the multiple use but as features which modify the feasibility rating of the area for primary production. For example, mining areas found in parts of the Great Clay Belt necessitate the separation of these areas from the rest of the Clay Belt. This is done not for the purpose of identifying mining as a use in the land-use pattern but to recognize the differences in feasibility in the use of these lands for farm and timber production from that of the remaining part because of the impact which the mines have on markets for farm and timber crops and on availability of manpower and similar effects.

A more specific but also more cumbersome name for these regions would be 'Primary Multiple-Use Regions".

Primary multiple-use regions provide a means of comparing in a broad way the relative outputs from a sliding scale of inputs from each physiographic component of the various regions. Such comparisons are useful to such agencies as the Ontario Department of Lands and Forests in their budgeting program.

Boundaries. The boundaries of these regions are based on broad differences in physiography and not on political boundaries. In such cases, the boundaries are distinct, such as those of the southern limit of the Pre-Cambrian Rocklands and of the Bruce Limestone Plains. In other areas, the transition zone is wide and the

boundaries will be established arbitrarily. In such cases, a political boundary may be chosen which will facilitate converting patterns of multiple-use regions into planning regions.

Criteria for Establishing Multiple-Use Regions. The criteria useful in determining the boundaries of multiple-use regions of primary production are as follows:

(a) Patterns of potential production as provided by use-capability ratings for agriculture, forestry, etc.
(b) Distribution pattern of minerals and potential energy.
(c) Patterns of present use and condition of the land and the cost of changing from present to proposed technology and levels of production.
(d) Range in availability of marketing and processing facilities.

The land, water and landscape units outlined above facilitate the location of area boundaries and the obtaining of the necessary basic data for policy decisions at the provincial and regional level. Before such decisions can be made for each development area, the area data must be evaluated within the regional and provincial context. The lack of consideration of the potential differential between multiple-use regions in economic development planning leads to bias of serious proportions. For instance, it has led to the unsatisfactory regions proposed for Northern Ontario in the report of Smith et al (1967).

3.462 Development Regions. Definition of Development Regions. The development region is a grouping of landscape units into a broad area which has a potential for the development of both the land and human resources which is fairly uniform throughout. It may therefore be one with a narrow range of land potential for the development of land-based resources such as mining, farming, timber , fish and wildlife production and recreation or combinations of these, or it may be a centre of population which is, or has the potential to become,a propulsion pole around which a greater urbanistic development will take place. Commonly, a development region can be considered either land-oriented or population-oriented. However, eventually patterns of both physiographic and population structure must be considered, particularly if these areas are to be used as regions of governmental implementation.

Development regions are usually larger than a single township, being part or all of one or more counties (or districts). The rural development regions are generally larger than the urban development regions, although not necessarily so. The governmental regions proposed in the Smith Report approximate the development region in both size and relative homogeneity.

Accordingly, the development region is a unit which is suitable for study at a basic level of generalization but seldom presents an opportunity for realizing fully that diversified type of economy which provides for the optimum development of both the human and land resources.

Criteria for Establishing Development Regions. The criteria for establishing development regions should be considered at the three levels discussed below.

(a) Criteria for Establishing Development Regions of Primary Production. These are synonymous to primary multiple-use regions discussed in the preceding section.

All of Ontario except the urban areas can be divided into primary multiple-use regions but development regions of primary production are found only where secondary and tertiary industries are not an important part of the economy.

(b) Criteria for Establishing Development Areas of Combined Activities. These are areas in which secondary, tertiary and quarternary activities play important roles. Primary industries may or may not be present in the region at recognizable levels.

In this type of development region, homogeneity is usually derived from a specific type of structure and function of the industrial and service industries. A region of this type is characterized by a relatively homogeneous land resource potential for biological production and a narrow range in transportation potential. Other factors of importance include the distribution pattern of mineral and energy resources and of population, industries and services.

All of Ontario can be placed in this, the preceding or the urban category, providing the study aspects of planning only are considered. Areas designed for the decision-making and implementation aspects of planning must be considered further in the next section.

(c) Criteria for Converting Development Regions into Government Implementation Regions. As an instrument for the implementation of decisions, the development region may be better suited than the planning region for the reasons stated as criteria in the report of Smith et al (1967), namely, those which contribute to a balance between facilities for government-public communication and servicing.

Although the implementation may be made by government at the mid-level, namely, metropolitan council, and other councils at the municipal-region level, county-region council, district-region council, etc.[1], the plans implemented should reflect decisions made at the three levels, namely, provincial, regional and local.

The following criteria presented in the Smith Report indicate the additional criteria required for a development region to meet the requirements of this mid-order level of government:

(i) Combination of historical, geographical, economic and sociological characteristics to provide a sense of community approaching that of a regional identification.
(ii) Balance of diverse interests within boundaries.
(iii) Adequate tax base for service equalization.
(iv) Capacity to confer area-wide benefits with greatest efficiencies of scale, equalization and the application of modern technology.
(v) Full knowledge of their position of resource-potential and benefit-share relative to other areas in the region and province and an ability to discharge certain co-operative functions.
(vi) Adequate access to the services discussed above.

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[1]As proposed by Smith et al (1967) and others: an accomplished fact for Metropolitan Toronto and the recently established municipal regions such as Ottawa-Carleton.

Size. The size of development regions varies according to the potential and diversity of the land and human resources and the stage in the development of transportation and urban services.

Since these categories approximate the metropolitan, county and district organization in Ontario, some notion of minimum areas can be derived from the present organization, unsatisfactory as it is as presently constituted.

The minimum for metropolitan regions should not be less than 200 square miles (the size of the present Metropolitan Toronto is approximately 241 square miles).

The minimum size of the county regions should not be less than 400 square miles (the size of Lincoln, the smallest county in Ontario, is 332 square miles (land area)).

The minimum size of the district regions should be 400 square miles, the same as the county region. It might seem that the size of district regions should be larger to compensate for lower production. The land area of Muskoka, the smallest district in Ontario, is 1,585 square miles. However, the transportation facilities are not sufficiently well developed in most hinterland areas to permit a highly developed government organization within a broad area. Accordingly, the minimum for the district region should be no larger than the 'county region' regardless of its lower production, except for a specialized type of development. For example, in the development of wilderness recreational areas, such as Algonquin Park (area 2,910 square miles), larger areas may be considered.

Boundaries of Development Regions. Geographic regions are recognized by core areas which are separated from the core areas of other regions by a transition zone usually of considerable width. This requires that the location of a boundary line must be made somewhat arbitrarily. A marked discontinuity of physical features within the transition zone is helpful in locating boundaries.

However, in order that plans for geographic development can be actually implemented, the boundaries of the development regions should coincide with areas over which a single governing body has jurisdiction. This is not possible at the present time. In the first place, the present mid-order governing body, e.g., the county council, does not have the power to implement plans. In the second place, there are few county boundaries[1] which approximate the boundary between natural physiographic divisions.

The fact that there is no satisfactory mid-order government organization at present has encouraged the writers of the Smith Report to suggest regions which do not coincide with the present counties or districts. However, boundaries of those proposed by Smith do not reflect differences in potential land resources as well as they could.

[1] The boundaries of most of the proposed municipal regions presently follow the county boundaries. These boundaries may subsequently be changed.

It is suggested that where there are organized townships in the transition zone between regions, these should be divided into segments by the boundaries of landscape units. Townships or convenient portions of townships should then be placed in alternative regions according to the dominant characteristics of the landscape units into which the townships have been divided. This requires that the natural landscape features be interpreted in terms of the potential land resource related to prospective economic development.

3.463 Geographic Planning Regions. Definition. A geographic planning region is a relatively large area comprised of a number of relatively homogeneous development regions which are presently functionally integrated or exhibit a potential for this integration. The objective is to group development regions which, though they may be diverse in nature (advantageously so), are complementary to one another. For example, it is essential that areas of recreational potential be included with urbanizing areas in the same regional plan, providing they are suitably located.

These broader regions, being patterns of development regions, are useful instruments for that type of analysis and decision-making which integrates the plans, policies and programs of provincial, regional and local governments.

Criteria for Establishing Regions for Development Planning. The criteria are those features which control either the present or potential development of the following:

(a) The primary industries (farming, timber production, mining, etc.).
(b) Multiple-use natural areas to provide high quality natural environment.
(c) The secondary industries developed within areas dominated by primary industries and related to them.
(d) Secondary and tertiary industries developed in proximity to transportation routes and for metropolitan areas.
(e) Highly organized secondary, tertiary and quaternary industries of metropolitan areas.

Since the present stage of development of industries, of population, and of service and marketing functions does not necessarily indicate the full potential of the region, knowledge of this can be used for the purpose of planning only to the degree that the relationship between present and potential development is known. A projection of the development pattern cannot be made until the level, type and location of the planned input is specified.

It now becomes evident that planning regions should be as broad as is necessary to include in one region all the development regions which are now or will be in the future more closely associated with the areas which form the core of that specific planning region than with areas which form cores of adjacent planning regions.

In order that the potential for both urban growth and primary productivity be fully recognized and integrated, the two main controls, namely, physiographic and demographic potential must be examined, both separately and in combination.

Physiographic structure refers to all the non-living physical features, including landform, waterform, soil and climate.

Demographic structure refers to distribution patterns of populations of many classes (age, occupation, etc.).

In summary, the criteria are:

(a) Physiographic Structure indicating levels of potential for:

(i) Biological production
(food, timber , wildlife, recreational landscapes, etc.)
(ii) Mineral production
(iii) Energy development
(iv) Transportation routes
(v) Domestic water supply
(vi) Amenities for human occupancy
(regional and local climate, recreational land and water forms, etc.)

(b) Demographic Structure indicating:

(i) Present development
- present services
- present labour force
- present markets
(ii) Potential development
This can be predicted only through a study of the relationship between present demographic structure and physiographic potential. Projection to be relative to:
- future production (input, output and type of management)
- future labour force
- future markets

(c) Interrelationships between Physiographic and Demographic Structure

Examples:
(i) Areas of biological production in relation to present services, labour force and markets.
(ii) Amenities of human occupance in relation to metropolitan and urbanized areas.
(iii) Transportation routes in relation to metropolitan and urbanized areas on the one hand, and primary production areas on the other.
(iv) Supply of energy in relation to human and natural resource potential.
(v) Domestic water supply in relation to human and biological production potential.
(vi) Mineral production in relation to transportation and marketing facilities.

Size of Geographic Planning Regions. The size of geographic planning regions varies considerably depending upon the areas of 'hinterland' which are included within the geographic cores. The present Eastern Ontario region is approximately 10,000 square miles.

Boundaries of Geographic Planning Regions. Since geographic planning regions are comprised of geographic development regions, the boundaries of the latter become the boundaries of the former wherever they meet adjoining regions.

In hinterland areas between the cores of planning regions, the boundaries of development regions are not finalized until the total regional complex is analysed and differentiated both from above and below. It is possible that a multiple-use region may be placed eventually in two geographic planning regions when these are established. The two parts may then be viewed as two multiple-use regions.

3.5 LAND EVALUATION

This system of land classification (see section 3.1) is a formalization for mapping of those final land appraisals needed for land-use planning. The ultimate type of appraisal is land-use feasibility, which develops from the feasibility evaluation of the local site.

3.51 Land-Use Feasibility

Land-use feasibility is that type of land evaluation which indicates the *relative* economic and social advantages of using specific areas for specific types of production. In common with capability and suitability ratings, feasibility classes may be used to *compare different areas for the same use*. However, unlike capability and suitability ratings, feasibility ratings are also established to indicate comparative differences in the *same* and *different areas for different uses.*

Feasibility is considered within each of the following levels of analysis:

(a) the individual property owner (entrepreneur)
(b) landscape or municipality
(c) county or region
(d) province
(e) nation.

The feasibility rating of any given area may change from level to level because of changes in the context for rating. For example, for a community of dairy farmers located near a small urban centre, the feasibility rating for dairying for the community as a whole will be higher than for the production of small fruits owing to the limitations of local markets for fruit. However, it is possible that, for a limited number of individuals, fruit production may be more feasible than dairying because of special skills of the operator to produce just enough to meet the local demands.

Change of context also results in changes of rating at the same level. For example, the feasibility of dairy farming on the same farm will differ depending upon whether the farmer has a contract for fluid milk or must sell on the powder milk market.

Outputs measured in terms of both dollars and cents and of human welfare are included in the feasibility ratings of the proposed approach. There are advantages in separating the procedure into two steps, namely:

(a) Relative economic advantage measured in terms of an input-output ratio based on dollars and cents.
(b) Relative welfare desirability measured in terms of an input-output ratio based on all human values.

Step (a) should not be the only consideration. Additional considerations must be made to include:

(a) The risks that would be run as well as the benefits to be derived.
(b) What is best for the individual is not always best for the community, province or nation.
(c) Many uses considered to be conflicting at the local economic level may be made complementary if viewed in the light of welfare at the county, province and national levels and in the light of future requirements.

It is possible to have a very high feasibility rating for the use of land for agriculture by the individual entrepreneur if the land is taxed on an agricultural basis and not as for urban development. However, for certain entrepreneurs such as those with poor health, the feasibility for agricultural use may be much lower and they may be anxious to sell to urban developers.

It is evident that what is best for the finances and welfare of the individual entrepreneur is not necessarily the best for the future 'health' of the province and of the nation.

3.6 THE ROLE OF SOIL SERIES IN THE PHYSIOGRAPHIC CLASSIFICATION OF LAND

The soil series mapped by the federal and provincial Departments of Agriculture are also taxonomic units. In common with the physiographic site types discussed above, the soil series represent a specified range of soil drainage on a specified range of parent soil materials. It might be inferred, then, that the group of soil series which forms a soil moisture gradient on the same parent materials and known as a 'soil catena' would differ little from the landtype defined above. However, there are certain fundamental differences which arise from differences in the objectives and methods of the two classifications.

The objective of the soil classification (series and catenas) is to define areas having a narrow range of soil profile characteristics and thus to distinguish areas which differ in those facets of biological production which are controlled by the features of the soil profile (Hills et al, 1944).

The objective of the site classification (physiographic site types and landtypes) on the other hand is a broader one, namely, to define areas having a relatively narrow range in potential, not only for controlling soil profile development, but for other features of significance in the total productivity system, such as the development of specific types of vegetation under natural and cultural controls. Although the range in soil materials used in the site

classification is relatively narrow, it will be evident from the following discussion that theoretically it is generally broader than the ranges used to establish the soil series (Hills and Morwick 1944).

Examining the criteria used in establishing soil series we find that the absolute range in soil moisture, and in texture, structure and petrography of the parent soil material is not constant but varies from one series to another, depending on a number of factors, largely those which determine differences in the characteristics of the soil profile used to separate one series from another (Hills 1942). The range in soil moisture and characteristics of parent soil material included in a soil series may be also broadened to provide units mappable at the scale used on the soil survey. Furthermore, the range of variations in the soil profile characteristics are frequently narrower in areas of intensive agricultural use than in areas of extensive or non-agricultural use.

Since soil profile characteristics and not parent materials or climate are used to establish the soil series, a specific series may be found in several climatic regions owing to variations in combinations of parent material, relief and vegetation compensating for differences in the regional climate.

The soil series has an important role to play as an indicator of the type of productivity system resulting from the combined effect of climate, relief, parent materials, soil water and vegetation. *To be of greatest indicator value, however, the soil series must be used within defined ranges of regional climate, local climate, and relief, texture, structure and petrography of parent soil materials, namely, within a framework such as the physiographic site classification described in this paper* (see Hills 1958).

Examining the criteria used in establishing physiographic site types, we find that the range in texture, petrography and depth of parent soil material, though broad, remains fixed for each landtype. This fixity provides the basis for establishing the effect of differences in vegetation succession and management practice on the kind and character of the soil horizons which develop on each of the various soil moisture conditions.

Since the range in characteristics in parent soil material used in establishing landtypes is usually broader than that used in establishing the catena, a physiographic site type will theoretically embrace more than one soil series. The number of soil series per physiographic site type varies, depending upon the range of parent materials which occur in any region and the degree of refinement used in establishing soil series in any particular area. The major reasons for more than one taxonomic soil series within each taxonomic physiographic site type are as follows:

(a) Differences in geologic origin of the materials of same texture and petrography. (Soil series are usually specific for each of till, lacustrine, deltaic and outwash materials. Sub-landtypes, based on geologic origin and relief patterns and generally equivalent to catenas[1], are recognized easily from aerial photos and constitute an important part of a forest land classification.)

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[1]providing one great soil group only develops on each material class.

(b) Differences in structure and permeability. If a broad range of these characteristics occur in a site region, the physiographic site type is more closely equivalent to a family (of series) rather than to a single series.

(c) Differences in types of vegetation succession. On certain types of materials known as labile materials, the soil profile characteristics are easily changed. Profiles belonging to two great soil groups develop, for example, a podsol under conifer and a brown podsolic under tolerant hardwoods.

However, in actual practice it has been found that the soil series as mapped in many areas is too heterogenous to constitute a useful unit for forest site evaluation. In fact, some mapped soil series have been found to be a pattern of physiographic site types differing in potential by as much as four forest use-capability classes out of the total range of seven classes (see table 4, section 6.22).

There are five reasons for this apparent anomaly:

(a) Inability to map soil series under the prescribed circumstances such as: (i) variable character of relief and geologic materials; (ii) lack of access to area; (iii) misinterpretation of air photos; (iv) lack of knowledge of geology.

(b) Differences in guidelines for establishing soil series.

(c) Requirements of site evaluation for forestry which differ from those of agriculture. For example, forest site evaluation requires a knowledge of soil and ground water profile greater than the standard three-foot length of soil auger of the agricultural soil survey. Thus, a sandy soil may be properly mapped as an excessively drained soil series but at six feet there is a water table which provides an adequate moisture supply to trees once established.

(d) The lack of uniformity of depth of the upper permeable layer over an impermeable lower strata such as is found when a wind-blown or superficial till overlies a moulded basal till. For example, there is sufficient variation of this kind in areas mapped as Honewood in Dufferin County to warrant a range of at least three agricultural use capability classes of the total scale of seven classes.

(e) Variations in levels of nutrient content of parent geological materials. The range in mineralogical composition and moisture content of soils mapped as Tioga Sand in Simcoe County is sufficient to warrant a range of five classes of forest use capability.

In spite of the above discrepancies, the soil series, as theoretically established, is a useful concept in land classification. The role of a soil series classification, however, is to provide a shorthand description of the soil profile of the site units mapped rather than to provide a mapping unit in itself. Soil maps can also provide background knowledge of the area useful in rating the productivity of the land if the actual distribution pattern of soil profile variations are indicated (Hills 1958).

Chapter 4

THE SIMCOE ECOLOGICAL REGION

4.0 REGIONAL ECOLOGY

The ecology of a region has been defined (Section 2.01) as that pattern of relationships between the living organisms of the region and their environment, relationships which determine the productivity of the region. Hence, the ecological features of the Simcoe Region are those features which interact to produce those goods and services which contribute to the welfare of the people of the region and elsewhere.

4.01 Transactionally Related Groups of Ecological Features

The nature of transactions is discussed in Section 2.42. The method of classifying landform in such a way that a specific landform pattern indicates a specific pattern of natural vegetation within a site region was discussed in Section 3.21. This landform-vegetation relationship is actually a more comprehensive one between landform, local climate, and soil water. There is also the relationship between ground water hydrology at greater than rooting depths and the geological materials at these depths which may or may not be recognized by surface landforms but which are generally part of a landform subprovince. Landform, climate and ground water are all part of the non-living environment known as physiography.

This intimate association of significant levels of ecological features suggests a single integrated scheme of description in which all features fit into an overall plan rather than a number of discrete descriptions which are superimposed one upon another. Landforms are described in terms of patterns of relief, geological materials, soil type and local climate in such a way that the areas which make up the pattern are homogeneous with respect to the effect which combinations of the landform features have upon production (Hills and Boissonneau, 1960, 112-123). This physiographic control determines the potential production of natural vegetation at various stages of succession and of the various cultural cover types. With the specific plant communities representing natural and cultural cover types there are associated animal communities which constitute the biotic communities which are characteristic of the region.

Although it is impossible to include a full ecological description of the region in this short chapter, the following brief description of landform patterns should provide the regional framework for ecological analyses.

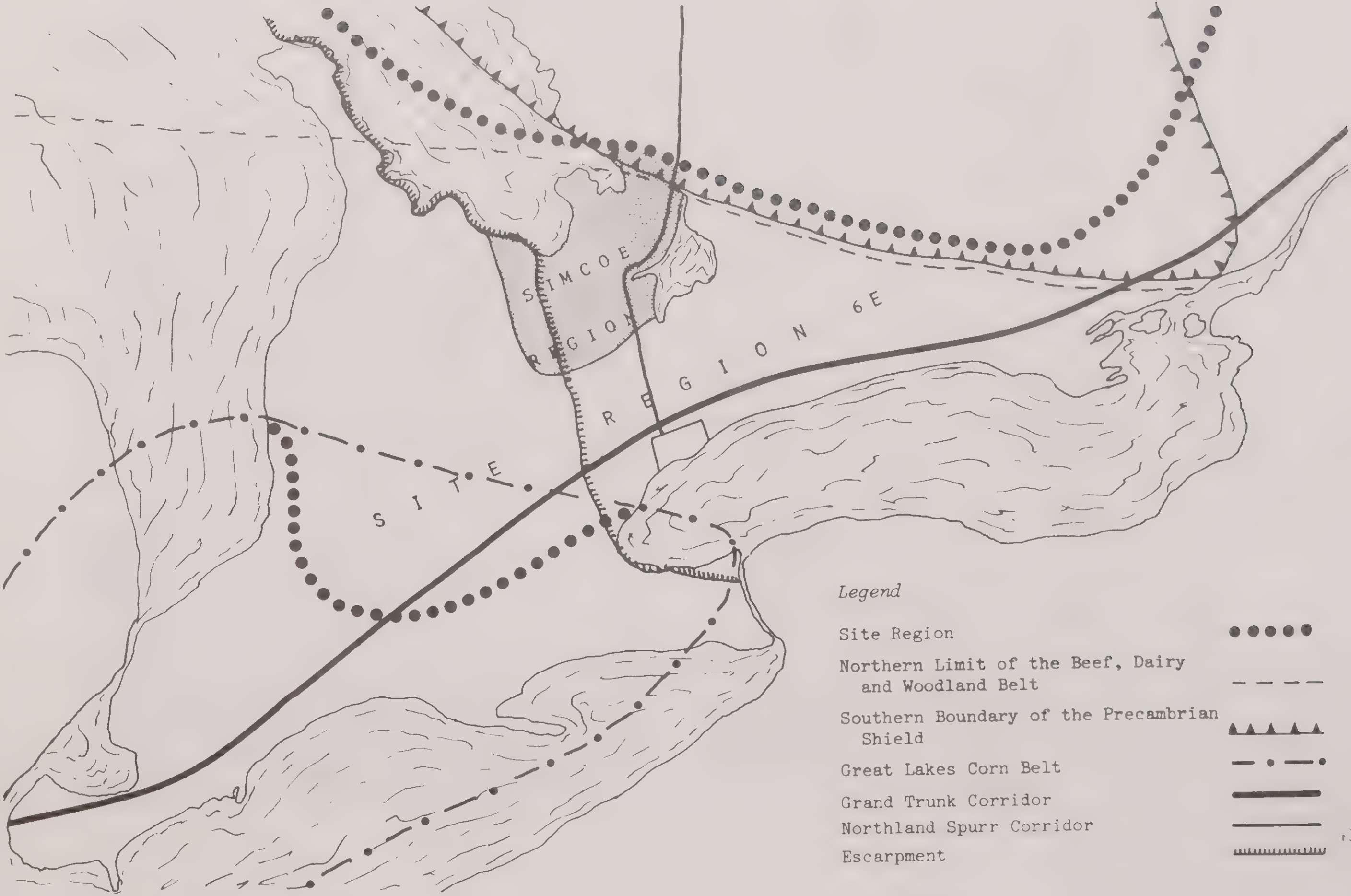
4.02 Geographical Setting of the Simcoe Region

The ecologic and geographic position of the Simcoe Region is shown on Map 1.

4.021 Regional Climate. Sanderson (1948) using the Thornthwaite classification places the region in the humid mesothermal category. More specific is Chapman and Brown's (1966) classification for agricultural production. These authors have divided Canada into 63 climatic regions by combining seven temperature zones with nine moisture classes. Most of the Simcoe Region below the escarpment lies

Map 1

Geographical Setting of the Simcoe Region



in a 3H region. The characteristics of the H moisture class are (a) 1-3 inches of water deficiency, and (b) 13-15 inches of precipitation May to September. Class H is the most favourable moisture regime in Canada and crop failures due to drought seldom occur. There is a narrow strip of slightly drier climate, Class G, around Georgian Bay.

That part of the region below the escarpment lies in Temperature Class 3, having between 3000 and 3250 degree days above 42°F. There are only a few areas in Canada having a more favourable temperature regime. These are found mostly in Southern Ontario and British Columbia. The main area of Class 1 is Essex and Kent County with over 4000 degree days above 42°F.

A climatic feature of significance is Chapman and Brown's (1966) classification of Corn Heat Units (CHU). Most areas below escarpment are above 2500 CHU, which is minimal for grain corn; areas above escarpment are rated 2300 CHU, which is above minimal for growing silage corn.

4.022 Bedrock Geology of the Region*. The bedrock of the Lake Simcoe Region consists of roughly parallel bands of Paleozoic rock of mainly Ordovician and Silurian limestone shale (overlying the Precambrian Shield). The widest of these bands extends from Coldwater and Washago to Collingwood and Aurora, forming a broad plain underlain by the Black River and Trenton limestone. In places the Black River limestone overlooks the Shield in a low escarpment forming the edge of a rock plain; this zone of shallow soil marks the passage of the Georgian Bay-Lake Simcoe lobe of the Continental ice sheet. The western boundary of the basin is marked by a series of shale formations, most important of which are the Meaford-Dundas (gray) and the Queenston (red). Above the shales the rim of the escarpment is composed of almost vertical cliffs of Lockport dolomite standing 100 feet or more above the shaley slopes below. On the dip slope of the Niagara cuesta lies still another dolomite member, the Guelph formation. The Niagara Escarpment, standing more than 1000 feet above Georgian Bay behind Collingwood, is easily the most striking feature of Southern Ontario and is the source of many of the streams flowing through the Lake Simcoe Region.

4.023 Regional Landform. The region is part of the Great Lakes-St. Lawrence Lowland, an area of deep pleistocene deposits. In the Simcoe Region these are derived largely from Paleozoic limestone and some shale.

4.024 Forest Region. The Simcoe Region lies in the Huron-Ontario section of Halliday's Great Lakes-St. Lawrence Forest Region, characterized by a mixed hardwood pine hemlock forest (Rowe, 1959). Lucy Braun (1950) places the area in Great Lakes-St. Lawrence division of the Hemlock White Pine Northern Hardwoods Region.

4.025 Soil Zone. The Simcoe Region lies in the Grey Brown Podsolic Soil Zone, the patterns of which have been described by Hills, (1944). Within the region there is a range of Great Soil Groups depending upon the degree of concentration of limestone fragments and of carbonates in the geological materials as follows:

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*The authors are indebted to Dr. D. F. Putnam for this statement of the bedrock geology of the Region.

(a) Brown Forest Group in the stony and gravelly limestone materials,
(b) Grey Brown Podsolic Group in high lime materials, and
(c) Bisequia type profile in moderate to low lime materials -
  (i) under hardwood: Brown Podsolic within upper part of Grey Brown Podsolic,
  (ii) under conifer: Podsol within the upper part of Grey Brown Podsolic.

4.026 Site Region 6E. The vegetation-landform relationships for this region have been summarized from Ecological Basis for Land Use Planning (Hills, 1961).

Most stable forest community on hotter than normal landform:

Dry Soil	- Butternut, White Pine, Red Pine
Fresh Soil	- Shagbark Hickory, Red Oak, Beech
Wet Soil	- Green Ash, Silver Maple, Red Maple

Most stable forest community on normal landform:

Dry Soil	- Hard Maple, Beech, Red Oak
Fresh Soil	- Beech, Hard Maple, White Oak
Wet Soil	- Hemlock, Silver Maple, Cedar

Most stable forest community on colder than normal landform:

Dry Soil	- Hemlock, Cedar, White Pine
Fresh Soil	- White Spruce, Balsam Fir
Wet Soil	- Black Spruce, Cedar, Larch

For a more specific discussion of regional ecological relationships between Site Region 6E and other site regions in Ontario and elsewhere, see A Ready Reference to the Description of Land in Ontario and Its Productivity (Hills, 1959).

Site Region 6E provides the areal limits for the ranges expressed in regional scales such as Capability Classes A to G.

4.027 Agricultural Regions. The Simcoe Region lies in the Ontario portion of the Eastern North Americana Dairy Beef and Woodland Belt. It is a potential area for the extension of the Great Lakes Corn Belt (Section 4.021).

4.028 Regional Geographic Relationships. The region is a strategic area within the developing southern Ontario megalopolis. At present it is a dominantly rural area with centres of increasing urban opportunity developing along the spur corridor from the Toronto hub to northland resources.

4.03 Ecological and Geographical Features Which Unify the Simcoe Region

The Simcoe Region in common with other geographic regions possesses natural and cultural features which make this area a convenient planning unit. It has, as do other regions, various degrees of affinity with its neighbours through extensions into these regions of the unifying features from within it.

The principal physiographic unifying or homogenizing features in the Simcoe Region are a smooth central plain, mainly the valley of the Nottawasaga River, flanked by two morainic ridges, one to the east and the other to the west. The area is bounded on the east and the north by Lakes Simcoe and Couchiching, the Severn River and various bays and inlets of Georgian Bay.

The shore waters of these lakes and bays are part of the Simcoe Region. The Niagara Escarpment might be considered to be the western boundary. However, from the standpoint of land use, the narrow face of the escarpment is not a unit in itself. Land both at the foot and above the face must also be included in the escarpment unit. The basis for considering the Beaver Valley as part of the Simcoe Regional ecosystem is that it is enclosed by a westward extension of the Niagara Escarpment from the Blue Mountains of the Collingwood area and is linked to Collingwood and Wasaga by the beaches and backshores of Nottawasaga Bay.

In addition to the homogenizing influence of the landforms mentioned above, there are the lake waters which in places provide harbour sites around which urbanization may develop. Within the region on the east is the rapidly developing transportation corridor to the 'Muskoka' resorts. Not so fully developed is the potential for a second transportation corridor to the west along the top of the escarpment. The development of this corridor brings into the region those areas north of Shelbourne to round out the region.

4.1 THE ECOLOGICAL PATTERNS OF THE SIMCOE REGION BASED ON PHYSIOGRAPHY

In the following descriptions of landform patterns the term landform has been used in place of eco-landform because of the awkward form of the latter. However, the intent is to include in the concept the relationships inferred in the term eco-landform. Under the heading 'Land-use Ecology' only general statements are made concerning present and potential production.

The non-living features (physiography) of the Simcoe environment are discussed in a number of reports at various levels of detail and for different portions of the region. The glacial geology and landform patterns of the entire region have been discussed by L.J. Chapman and D.T. Putnam in their "Physiography of Southern Ontario". A more detailed description of the glacial geology in the Barrie area is presented by R.E. Deane (1950) in "Pleistocene Geology of the Lake Simcoe District, Ontario." N. Sibul and A.V. Choo-wng in their forthcoming report of the Ontario Water Resources Commission entitled, "The Water Resources of the Upper Nottawasaga River Basin", discuss the strata of glacial deposits in detail, particularly from the viewpoint of groundwater aquifers.

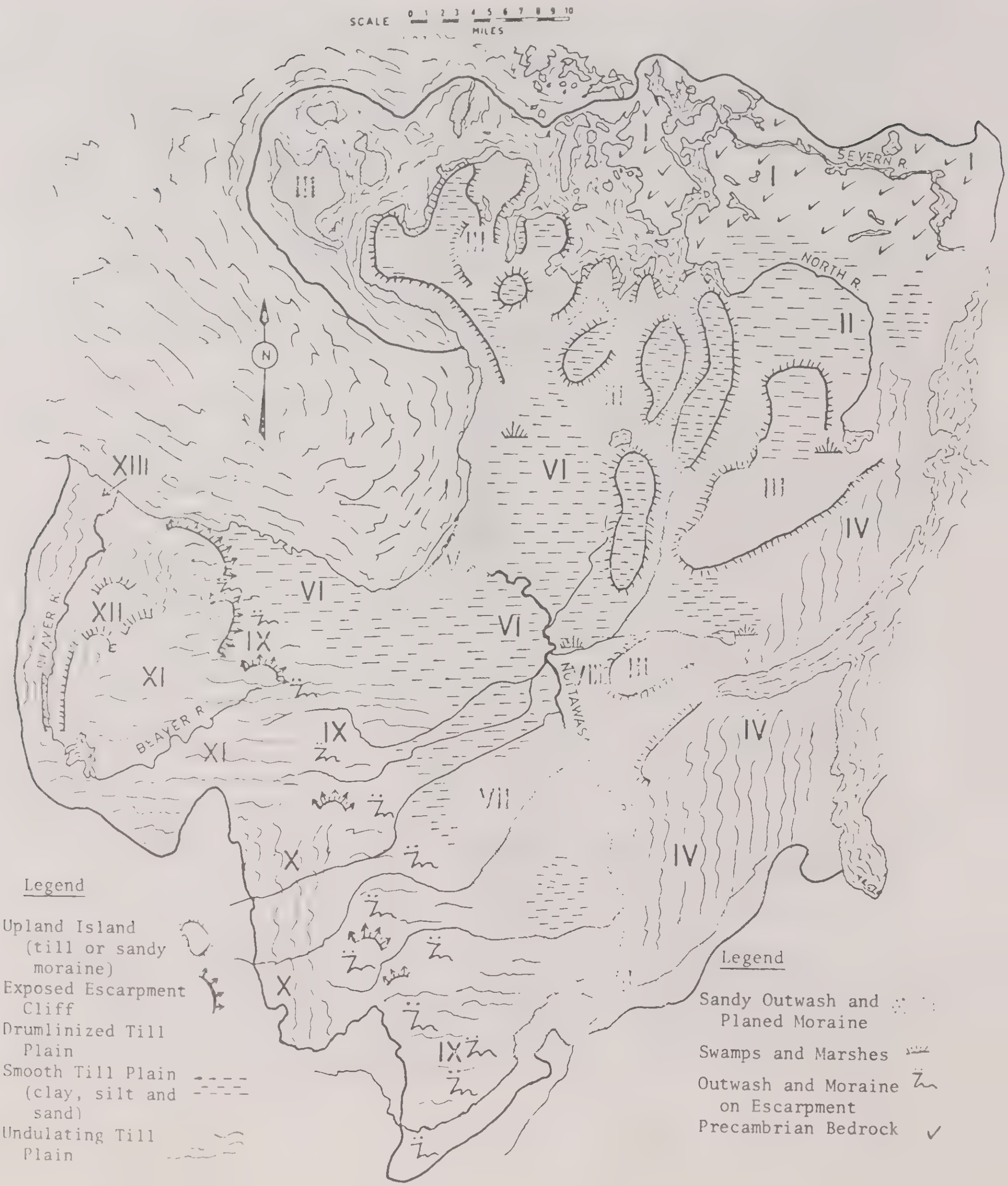
With the aid of such reports and of ecological observations in the field, the region has been divided into the thirteen landform patterns for the purpose of describing the regional ecology. These patterns, numbered I to XIII, are shown on Map 2.

4.11 The Severn River Granitic Bedrock Plain - (Pattern I)

4.111 Landform and Soils. A large area of Precambrian gneissic bedrock occupies the north east portion of the Simcoe Region. This area is very smooth compared with many other Precambrian areas. In the most northerly part of this plain, the bedrock is bare over much of the area with some local areas having a mantle of mineral or organic material.

Map 2

Landform Patterns of the Simcoe Region



Although bedrock outcrops are common in the remainder of the area to the south, there are pockets of deeper soil ranging up to a depth of 10 feet or more, much of which is a clay or silt loam. On the east there are considerable areas of sandy soils.

The soils on this almost level plain of Precambrian gneiss are mapped as a complex of 'bedrock' and poorly drained Atherley clay.

4.112 Climate. The local climates are generally cooler with greater day-night variations than are found on the plains of deeper materials to the south.

4.113 Land-use Ecology. The better water-holding and nutrient-providing capacity of the shallow clay pockets cause them to be higher producers than areas of other soil materials of equal depth. However, the extreme shallowness and small areas of these patches result in a low capability rating. Because of the greater need for space relative to food and lodging, wildlife is the chief production on this landform pattern. This is undoubtedly the best land use to utilize the more productive patches because of the mobility of the wildlife. The potential of these areas, low as it is, can be utilized to the highest degree by (a) managing wildlife, (b) preventing fires, and (c) encouraging damming of small streams by beavers to maintain surface water levels. It is doubtful if timber will ever be an important product on these areas.

Many of the waters of the Severn River and adjoining lands have moderate to low recreation potential. This potential depends upon the aesthetic and wildlife producing qualities of the area. The most valuable attribute of the area, which is largely bare bedrock, is space for humans as well as for wildlife.

4.12 The North River Clay Pocket Rockland - (Pattern II)

4.121 Landform and Soil. Much of this area is similar to the preceding except that the unconsolidated materials are deeper and occur in larger patches. Included in the eastern part of this area is a shallowly covered Paleozoic limestone plain. Another characteristic of the eastern portion is sandy and loam materials. Both these and the clay materials vary in lime content from very low to very high.

The soil series commonly occurring on these landforms are:

(a) Medonte, Lovering and Atherley series being the well drained, imperfectly drained and poorly drained members of a catena of clay soils either waterlaid or icelaid. Typically slightly acid, a wide range of lime content in the purest material has been found.
(b) Well drained loam till soil (i) Vasey loam either calcareous or non-calcareous and (ii) the limey Osprey loam and (iii) very high lime Otonabee loam.
(c) The Farmington loam less than one foot over Paleozoic limestone bedrock.

4.122 Climate. A pattern of normal and colder than normal local climates characterizes this area.

4.123 Land-use Ecology. Shallowness over bedrock is a limiting factor over much of the area. Furthermore, the brokenness of the area through shallowness of soil and extreme stoniness limits the development of a farm economy. There are a few local areas which are large enough to support a viable farm operation if all the land could be consolidated for this purpose. However, the number of such farm units within a land unit is too small to support a viable farm community. Alternative uses for such land units are a pasture or timber economy.

4.13 The North Simcoe Flat-Topped Moraine - (Pattern III)

4.131 Landform and Soil. This pattern is comprised of a number of upland areas ranging in size from one to 50 square miles in extent having relatively flat tops and steep slopes representing differences in relative mass elevation of 100 to 400 feet. These upland areas resemble closely clustered islands separated by flats of sand with occasional clay and marsh areas.

Much of the material in the slopes of these upland 'islands' are of a sandy or gravelly nature suggesting that the original landform was a sandy kame moraine, and that the original knolls were planed off during a subsequent glaciation. In addition to the sand and gravel obtained from the underlying kame, the overriding glacier also carried a load of clay and loam and stony materials picked up in the adjacent lacustrine and morainic areas. All of these materials are intermixed to varying degrees. Generally the till capping is a coarse-textured, stony loam but there are many local areas, of limited extent and unmapped, ranging from a coarse sand to a clay loam.

A large area of sands and gravel lying between Craighurst and Bass Lake lacks the capping of loamy, stony till common elsewhere and was set apart by geologist Deane (1950) as the Bass Lake Moraine. However, this area does not exhibit a strong kame and kettle relief. There is also indication of a till structure in the upper strata with little apparent difference in texture. For this reason this area is included with the other flat-topped uplands.

Most of the till on the upland flats has been mapped as the Vasey series with a wide range in lime content, topography and stoniness.

The soils developed on the exposed sandy and gravelly materials on the slopes and in the valleys between the uplands are mapped as Tioga sand and Sargent gravel. Some of the areas in which these materials 'outcrop' at the surface are also indicated on the map as Tioga sand or Wyevale gravel. There are also many other areas of such outcrops too small or too 'elusive' to map which have been included in the Vasey areas.

4.132 Climate. There is a wide range of local climates in this flat-top moraine terrain. Generally, the top flats are normal for the region and the narrow valley flats are cooler than normal. A very small proportion of the area is warmer than normal; these are upper valley slopes and coves which are protected and have good air drainage.

4.133 Land-use Ecology. The soils of this pattern, even those such as the Vasey and Tioga which are mapped as a homogenous series, have a wide range in degree of stoniness, and in the capacity to retain moisture and to provide plant nutrients. At the most favourable end of the range these soils have a moderate potential for biological production. But at the other end of the range, the soils may have one or more limitations which place them in a low to very low potential class.

The variability of the upper portion of the till sheet which caps the upland areas, even in areas mapped as one soil series, has been mentioned above. Thus variability is a limitation even in areas of field size since intensive agricultural production requires a uniformity of such factors as moisture retention. Original farm boundaries must often be disregarded in the marshalling of fields to form viable farm units[1]. Furthermore it is difficult to organize a uniform pattern of farm units within a farm community because of the general shape of the top flats which are often made more irregular by gullies and bouldery areas.

4.14 The Kempenfelt Moulded Till Plain - (Pattern IV)

4.141 Landform and Soil. The characteristic features of this area are largely those related to the relief and to the character of the materials which were moulded in place as the ice advanced over the area. The materials which were deposited later as the ice retreated over this same area are not usually deep enough to override the effect of the moulding either with respect to relief or permeability of the rooting zone. This variability in the depth of the deposited material has an effect on the capability rating causing it to rise at least one class where the deposit is deeper.

Most of the soils south of Kempenfelt Bay belong to the soil catena of which the Bondhead series is the well drained member. Bondhead loam is the most representative type. Bondhead sandy loam is mapped where the surficial strata is a sandy loam less than one foot deep over the till which is characteristic of the Bondhead. In areas where the surficial deposit is a sandy loam of depths ranging from one to three feet, the Dundonald series is mapped. A considerable area of the Guerin series which is the imperfectly drained associate of the Bondhead has been mapped. The imperfectly drained clay series, the Smithfield very high lime, occupies many of the small depressions.

A relatively small proportion of this plain north of Kempenfelt Bay has been mapped as bondhead; most of it has been mapped as Vasey. This area of Vasey soil differs, however, from those included in the flat-topped moraine to the north in that it shows greater evidence of stronger moulding and less evidence of being underlain by sand and gravel at shallow depths.

4.142 Climate. The ecoclimate varies within short distances but the range is seldom great. There are a few local depressions where colder than normal ecoclimates are found. There are also warmer than normal cove areas on some of the steeper slopes.

4.143 Land-use Ecology. The potential for biological production is relatively high. Although the Bondhead is moderately high in lime, the weathered profile is at least 18 inches deep, and is not as firmly moulded as some of the other till soils. Furthermore, the overlying material of surficial till usually provides greater depth of permeable lime-free soils facilitating optimum growing conditions.

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[1]Although there has been a trend in the direction of farm consolidation in Ontario for some time, it has not been particularly noticeable in the Simcoe Region. The most striking example in recent years in this area is the assembling of a large potato farm near Hillsdale.

Although inter-drumlin areas are frequently imperfectly to poorly drained, this feature does not commonly present a serious limitation in establishing viable farm and community units in the moulded till area south of Kempenfelt Bay.

4.15 Wasaga Sand Plain - (Pattern V)

4.151 Landform and Soil. Much of the surface deposit of this area is of recent origin being built up by the action of wind and water since Pleistocene times. The soil materials are typically fine to coarse sand. There is little or no profile development in a zone along the lake shore owing to water and wind erosion and deposition. Elsewhere weak podsols and grey brown podsolics have developed.

4.152 Climate. Although the moderating influence of Georgian Bay seldom extends more than a mile or so inland, this entire area would appear to be so affected, probably due to its physiography.

4.153 Land-use Ecology. In areas where the sands are at a high elevation relative to the water table there are limitations to the supply of moisture and nutrients. Generally, however, the water table is sufficiently close to the surface and the nutrient content is sufficiently high to support a moderate to high level of timber production.

There are serious limitations to the development of these lands for agriculture.

4.16 The North Nottawasaga Till-Capped Clay Plain - (Pattern VI)

4.161 Landform and Soil. This area is generally called a lacustrine plain. It has many lacustrine characteristics. It is a smooth plain and a casual examination of cross-sections a foot or so below the weathered profile often reveals the stratified laminated or varved clay of a recent or glacial lake deposit. More careful examination reveals a distribution of regularly stratified clays and silts associated with lacustrine materials which have been warped or otherwise modified as well as the typical unsorted till in combinations which indicate that overriding and ingestion by the glacier probably took place.

Whether or not this is correct, the soils of much of the area cannot be satisfactorily mapped at a scale of one mile to the inch. Furthermore, if the effort is made to map at a larger scale, more useful categories than the soil series are required to record the detail which can be obtained through a survey at this level. For this reason no attempt will be made to list and discuss the soils shown on the soil map for this area. Most of the soil profiles indicated in the legend can be found locally at one place or another in this area.

4.162 Climate. Topographically this area is similar to many having a relatively high proportion of cooler than normal ecoclimates in the wetter depressions. However, without meteorological data to prove otherwise, it must be assumed that a normal ecoclimate prevails with local pockets being colder than normal.

4.163 Land-use Ecology. In spite of the variation in these soils, the potential for biological production is relatively high. The generally high nutrient and moisture levels renders a uniformity of production under natural conditions which would not otherwise be attained. However, a given input which would overcome a limitation due to excess moisture (under natural conditions) in another area would not necessarily be as effective in this area of variable soil stratification.

This landform pattern possesses the main requirements of well-developed agricultural communities, namely, broad areas of level soil with adequate means of moisture retention and of aeration within the root zone. There is, however, that degree of variation within short distances that has been described for the flat-topped morainic area lying immediately to the east. This variability in the texture, compaction and position in the rooting profile increases the complexity and generally the cost of installing and maintaining an adequate drainage system.

4.17 South Nottawasaga Smooth Sand Plain - (Pattern VII)

4.171 Landform and Soil. This is a plain in which moderate lime and fine and silty sands are dominant. Local areas of coarse and medium sand occur; also areas of very fine sand and silt.

4.172 Climate. The frequent dissection of this plain of coarse to fine sands provides good soil and air drainage. Thus, normal ecoclimate is prevalent and hotter than normal ecoclimates are more common than colder than normal. Corn, tobacco and potatoes can be grown successfully.

4.173 Land-use Ecology. Over most of the area more moisture is retained than would normally be held by the dominant materials of the profile. This is due to relatively thin bands of fine sand and silt which support one or more perched water tables in the rooting zone. Because of this capacity to retain water, coupled with a highly satisfactory level of permeability and drainability, most of the soils in this area have a high potential for biological production. The natural level of plant nutrients is not high but the other favourable qualities of the land make possible the economic application of fertilizer supplements. There are local areas where irrigation is needed; this area is generally feasible for the production of cash crops such as tobacco and potatoes where water is locally available.

The organization of an agricultural economy at the farm and community level is easy on this broad area of level land. Gullied valleys of the stream courses are the only features which break up the land areas. These occur at such intervals that, from the standpoint of landscape aesthetics and water supply, they enhance rather than lower the community's potential.

4.18 The Minesing Fen and Swampland - (Pattern VIII)

4.181 Landform and Soil. This very extensive flat of wet organic soil is bordered on the south and east by the raised beach of ancient Lake Algonquin. An average depth of four feet of peat overlies highly calcareous marl. The peat layer varies from one foot to ten feet in depth. Beneath the marl is another layer of peat which is in turn underlain by yet another marl bed.

4.182 Natural Vegetation. On the edge of the swamp, where the soil is sufficiently dry to grow trees to commercial size, is a mixed woods of white cedar, red maple, white elm, balsam poplar, black ash and basswood. Although this fringe area has been cut extensively, the shrub and herb layers have survived quite well. Rare or unusual plants found in this community include blunt-leafed orchid (*Habenaria obtusata*), white adder's-mouth orchid (*Malaxis monophylla* var. *brachypoda*) and yellow lady-slipper orchid (*Cypripedium calceolus* var.*pubescens*).

On wetter land in the interior of the swamp there is a broad area of tamarack and black spruce. This is possibly the most extensive stand of black spruce south of the Canadian Shield. Large mats of sphagnum together with many ericaceous shrubs and herbs are present on deep accumulations of peat. Where the peat deposit is shallow, showy lady-slipper orchid (*Cypripedium reginae*) and purple-fringed orchid (*Habenaria psycodes*) abound.

In the centre of the swamp are many very wet clearings in which occur interesting and possibly unique plant communities. Parts of the clearings are occupied by 'jungles' of reed-grass (*Phragmites communis*), a 12-foot-tall grass. The wettest parts are covered by the short sedges, *Carex flava, Carex viridula, Rhynchospora alba,* and *Juncus* (sp.). The extremely rare prairie white-fringed orchid is found here in abundance. Several other uncommon plants accompany this beautiful rarity, including grass-pink (*Calopogon pulchellus*), Loesel's twayblade (*Liparis loeselii*), bog candle (*Habenaria dilatata*) and arrow-grass (*Triglochin maritima*).

4.183 Climate. Variations in the development of the natural vegetation in the various parts of the area suggest considerable variation in the local climate. It is unquestionable that the area has a pattern of 'colder than normal' and 'normal' ecoclimates, a pattern which has not yet been investigated by plant ecologists but intensive study is justified.

4.184 Land-use Ecology. The above description, more detailed than for the other ecological patterns, has been presented to provide the background for a new type of land use which requires much attention. It is the multiple use of natural areas in which a large proportion of selected areas must be preserved as ecological reserves. The following very brief outline[1] of the land-use ecology is intended to stress the dire consequences which may be expected if attempts are made to develop the area for agriculture, timber or wildlife production without regard for the ecological management of selected multiple use natural areas.

The presence of many of the unique plant communities described above is dependent upon the very specific nature of their environment. The water relations within the ecosystem exist in a delicate balance easily upset by changes in the water flow throughout the whole system. Therefore disturbances of the ecosystem such as damming the streams or blowing ponds in the organic soils to improve wildlife habitat should only be done where the flow of water will not be disturbed. A study of all the physiographic features (water, soil and local climate) should be made in relation to the total ecosystem, by qualified ecologists, if effective and undamaging use is to be made of the area.

4.19 The Simcoe Moraine-and-Outwash-Mantled Escarpment - (Pattern IX)

4.191 Landform and Soil. This is the area where the materials of a recessional moraine and outwash benches cover most of the face of the Niagara Escarpment except toward the north near Collingwood where it appears in bold relief and is known as 'the Blue Mountain'.

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[1]This is drawn from conversations with Dr. John Sparling, Department of Botany, University of Toronto, who is preparing a report on the area.

For the most part the till materials are loams, silt loams and clay loams with a moderate to high lime content. Locally, there are materials with a high shale content which render them less permeable than the limestone tills.

4.192 Climate. Although meteorological data are not available for verification, there are doubtless considerable variations in ecoclimate in this area of moderately broken terrain. Most of the valleys have good air drainage; in fact, a warmer than normal ecoclimate is often present. There are a few colder than normal areas in the broader stream flats. The morainic ridge tops and outwash terraces are usually normal in both effective temperature and humidity.

4.193 Land-use Ecology. In general, this area has a high potential for biological production, particularly under natural conditions which control sheet erosion and build up a site condition which permits the maximum uptake of water and nutrients from the soil.

4.20 The Dufferin Loess-Capped Moraine - (Pattern X)

4.201 Landform and Soil. The dominant material is a ground moraine which occurs locally in the form of drumlins and other ridges of moulded till. The till is a loam derived from dolomitic limestone and is similar to that on which the Harriston series is developed. In much of the area this till is covered to varying depths with stone-free, fine sand, very fine sand or silt cap.[1] This cap was probably laid down during the retreat of the ice and, most likely, a glacial wind deposit (loess).

This covering is usually lime-free due to leaching, possibly it originally had a moderate lime content.

The well-drained soils developed on the loess over till are mapped as Honeywood regardless of the depth of the overlying loess material. The imperfectly drained associate is the Embro and the poorly drained associate is the Crombie. The mapped areas of these two are limited in extent but not all the areas of Honeywood are well-drained.

Another soil type occupying a considerable area is the Caledon fine sandy loams developed in a fine, sandy loam cap similar to that of the Honeywood, but which is underlain by a limestone gravel and not till as in the case of Honeywood.

4.202 Climate. The climate of this area is generally similar to that which characterizes the entire South Grey uplands, namely, cooler and moister than normal.

4.203 Land-use Ecology. The very fine sandy loam and silt materials which constitute the parent material of the Honeywood have such a high degree of permeability coupled with moisture retention that their potential is very high from the standpoint of biological production. Their rating for agricultural production, particularly that for potatoes, is also very high, providing this surficial covering is deep over the underlying till. However, the depth of this material is variable over a till sheet of irregular relief. This causes springs to form on the side hills in which farm machinery may become mired at a time when the rest of the field should be tended.

[1]The Ontario soil survey suggests that it is either loess or alluvium.

If the potential of the Honeywood loam was rated on actual field characteristics it would range from Class 1 to Class 4 for agriculture. The A.R.D.A. map of Soil Capability for Agriculture (Canada Land Inventory Bruce - 41A; 1967) shows all of the Honeywood loam areas to be Class 1.

4.21 The Maxwell Limestone Till Plain - (Pattern XI)

4.211 Landform and Soils. This is a gently undulating area of stony to bouldery till derived from limestone, a large proportion of which is dolometic. The depth of till over the underlying limestone bedrock varies from a few inches to a foot in much of the Kolopore area and to ten feet or more over most of the remainder of the area.

Owing to the swell and depression character of the terrain and the somewhat impervious nature of the underlying materials, there are many smaller wet depressions scattered throughout the area in addition to larger swamps.

The most common soil series is the very stony Osprey loam which is recognized by its very shallow profile development on account of the liminess of the parent materials. Common also is Harriston silt loam developed on limestone till but with a deeper profile development than the Osprey.

4.212 Climate. Except for fringe areas near the edge of the escarpment this area has the cooler wetter climate with heavy snowfall which characterizes the entire Dundalk upland.

4.213 Land-use Ecology. Biological production is limited due to the high carbonate content which interferes with plant nutrition by reducing the availability of such elements as phosphorus and boron. With the exception of local patches of a few hundred acres each scattered throughout the area, the land does not have a high potential for agricultural use. The soils in these areas are less stony and more deeply weathered and are less broken by swamps and bouldery ridges.

Pastures are common, many of them being a 'permanent' pasture of Canada bluegrass. Although such pastures produce good beef, the production per acre is not as high as that from improved pastures which include alfalfa, birdsfoot treefoil and other legumes.

4.22 The Beaver Valley Till Slopes - (Pattern XII)

4.221 Landform and Soil. The lower and middle Beaver Valley occupies a broad northward-facing embayment in the Niagara Escarpment. In the middle valley which is narrower the slopes are shorter and moderately steep. In the lower valley the very long moderate gradients slope either to the Beaver River or to Georgian Bay. The common material is a fine texture limestone till much of which has been moulded into place by glacial action. Overlying the moulded till is a more permeable surficial till of varying depths.

The soil developing on these materials has been mapped as the Vincent silty clay loam. An eroded phase of this series has been mapped on the steeper slopes. The imperfectly drained associate Kemble clay occurs in scattered areas. Also there is an area of very flat, poorly drained clay located along the Beaver River above Heathcote mapped as Toledo clay.

4.222 Climate. The local climates of the long slopes facing the Beaver River and Georgian Bay have been studied intensively because of the potential of this area for apple growing. Mr. B. Findlay of the Meteorological Branch, Canada Department of Transport, demonstrated the use of his mobile laboratory in this area during the 1968 course. The following is a quote from a discussion by L. L. Wark, who preceded Findlay in the Beaver Valley investigations. The words in italics have been inserted by the authors to relate the locations mentioned to land units shown on the map.

"The mobile temperature surveys of February 7 and May 31 as well as several other surveys indicate that when there are in combination, light winds, clear skies and high atmospheric pressure, in Spring, Winter and Fall seasons, the minimum temperature distribution in the Beaver Valley may be described in terms of four thermal zones:

(a) A zone of relatively warm temperatures along the shoreline of Georgian Bay. *Land unit 44-15 in Land Use Pattern XIII.*

(b) A cold temperature zone in the deep valley of the Beaver River between Kimberley and Clarksburg. *Land unit 50-3.*

(c) A cold temperature zone beyond the rim of the escarpment, where there is a marked heat sink in a saucer-like depression, centred on the hamlet of Kolopore. *Land unit 36-1 Land Pattern XI.*

(d) A "Thermal-belt" zone of relatively warmer temperatures between 1100' and 1500' on both the east and west slopes of the Valley where air ponding in the valleys and air drainage on the crests of the hills is highly characteristic. *Land unit 86E-1, 86E-2, 86-5.*

"The two cold temperature zones result from topographic barriers which prevent down-valley air drainage. In the deep valley zone a cross-valley moraine 1/4 mile north of Heathcote, which is aligned at right angles to the down-valley flow of air drainage, causes accentuated air ponding and cold air stratification. The only outlet for the ponded air is by way of the narrow valley of the Beaver River.

"Beyond the rim of the escarpment a rock outcrop (50'-100' high), prevents unrestricted air drainage into the Beaver Valley from a saucer-like depression centred on Kolopore. There was marked cold air stratification south of this barrier on the two mornings of the mobile surveys." *Wark 1967.*

4.23 The Thornbury Sand Plain - (Pattern XIII)

4.231 Landform and Soil. Although dominantly a 'sandplain', this is an area in which stonefree sands, loamy, sandy and clay tills and water-laid gravels are found in intimate association. Designating the soils of this area as Brighton Sand and its imperfectly drained associate, the Tecumseh, has done little to sort out the differences which occur.

4.232 Climate. Most of this area comes under the modifying influence of Georgian Bay. Temperature differences between summer days and nights are not as great as inland. The growing season begins somewhat later in the spring but continues later in the fall.

4.233 Land-use Ecology. Those ecological relationships which are related to apple growing have high priority in land-use studies in this area. However, these relationships relate to the heterogeneity which exists rather than to the homogeneity implied by the soil map. Capability ratings are valuable only when based on the actual ecology of the area.

4.3 THE LANDSCAPE UNITS AND LAND UNITS OF THE SIMCOE REGION

The Simcoe Region was divided into land units and landscape units according to methods and criteria outlined in Sections 3.43 and 3.45. These are shown on Map 3 (page 87).

It will be observed that, in general, the landscape units are a subdivision of the 13 landform patterns described in Section 4.1. The criteria used for establishing landscape units include homogenizing cultural factors with the landform patterns which were established with reference to their potential for biological production only.

It is recommended that the land units and the landscape units be the areal units used in land-use planning. The information presented throughout the discussion of landform patterns can be applied in much the same way as other data such as soil series and glacial materials. This ecological treatment of landform should provide material in an assimilable form for integration with the more strictly human aspect of ecology.

4.4 SEQUENT HUMAN OCCUPANCE IN THE SIMCOE REGION

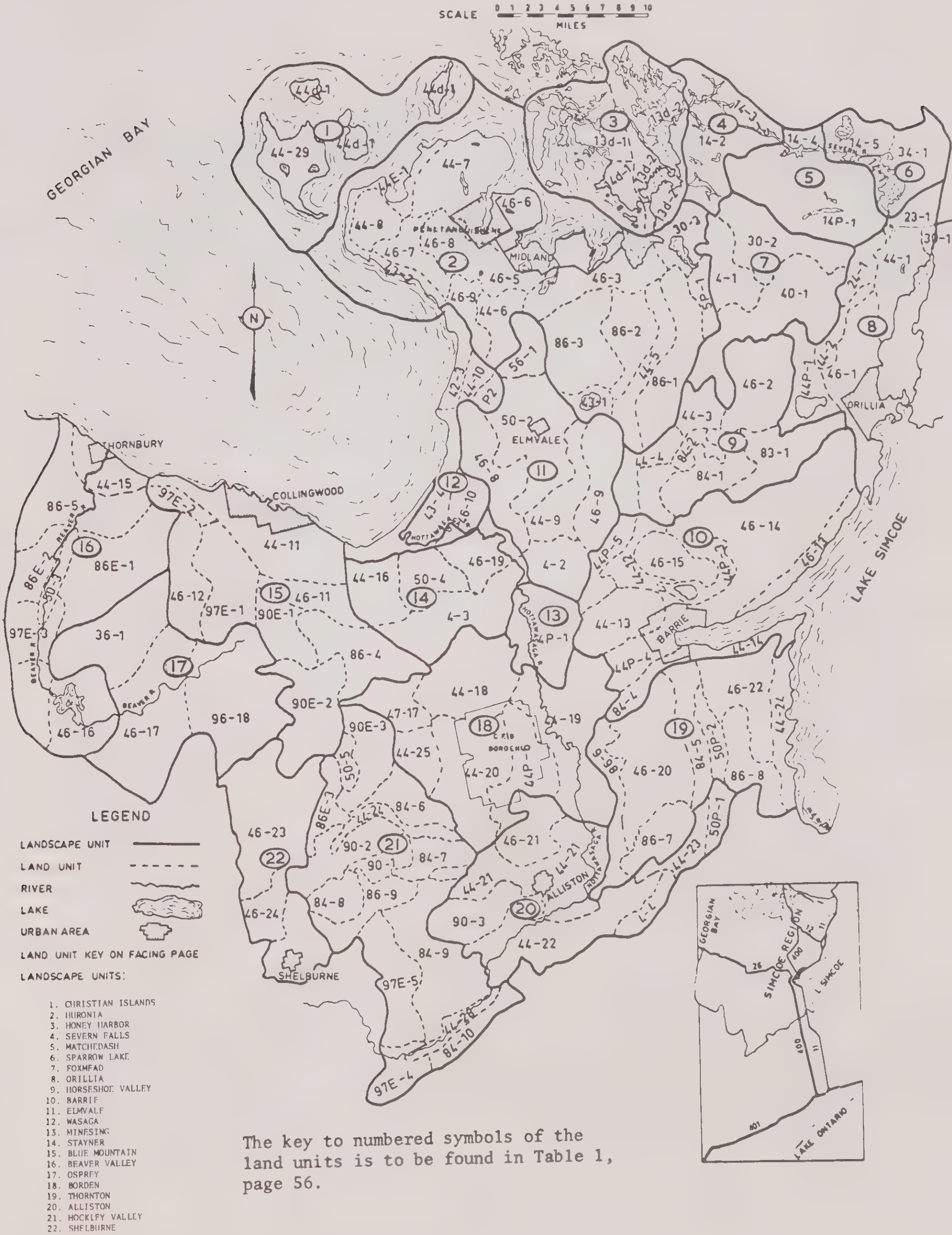
The nature of ecosystems is such that 'what they were' is now a part of 'what they are'. Hence the necessity to relate human occupance in the past to present features which may or may not be unique because of their history.

W.W. Fieguth in his paper, "The Personality of North Simcoe County", has compiled many interesting facts about the human occupance of the region and has related them to the region at the time of occupance. The 'series of sequent cultural stages - each impressing a distinct but not unrelated personality upon the area' which he discusses are as follows.

(a) Huron agricultural occupance, 1000 A.D. - 1650.
(b) Period of French penetration, 1611- 1650.
(c) British military occupance and pioneer stage, 1785-1853.
(d) Stage of lumbering, farming and upper class resorts, 1854-1891.
(e) Stage of urbanization and recreation, 1891-1966.

In conclusion, Fieguth states, "The elements of uniqueness that have been contributed to the regional personality by each phase of human occupance need to be stressed, therefore, as they enlarge the potential of the area for recreation."

Map 3   Landscape Units and Land Units of the Simcoe Region



The key to numbered symbols of the land units is to be found in Table 1, page 56.

It is important to note that Fieguth's analysis of the changing spatial relations and human occupance has pointed to a need for regional planning in order that the emerging patterns of urban and recreational occupance may enhance and not obliterate the regional heritage. This conclusion complements that of the present study of the natural environment. In this ecological study the shift to urbanization and recreational development has been recognized and projected into the future. The land-use teams of both 1968 and 1969 were convinced that careful planning was needed to assure, *inter alia*, the realization of a natural and cultural environment in the reserves of open space for agriculture, recreation and timber production. This thinking is reflected in the scenarios, Chapter 7.

Chapter 5

MANAGEMENT OF THE LAND RESOURCES OF THE SIMCOE REGION

5.0 SOME BASIC CONCEPTS

5.01 The Meaning of Management

The most important function of planning is to facilitate the integration of natural and human resources to provide for human needs in the most efficient manner. Only rarely will the natural resources provide their maximum contribution to society in their unmodified natural state. Usually, through manipulation by the application of human resources, the capacity of the natural resources to serve human needs will be greatly increased. The act of manipulation thus applied is called the management of the resource.

The various techniques and processes involved in the management of resources cover a very wide range, depending upon the nature of the basic resource and the goods or services which are to be realized from its use.

In this course, the land is considered to be the primary resource, any one specific area of which may have the capacity to serve different human needs. Thus a given area of land may have the characteristics required to produce food, timber, water, recreational space or a combination of two or more of these goods or services.

The level at which human needs may be satisfied from a specific area will depend in the first instance on the inherent capacity of the land to produce goods and services desirable to man, and secondly on the extent to which the area can effectively absorb human inputs designed to augment the output of desirable goods and services. In areas where the scenic value of the landscape is the desired output, human input in terms of resource manipulation may be entirely undesirable. However, to serve most of the needs of man, some manipulation of the land resources is economically effective. That is, through the expenditure of human effort on the land, the returns in goods and services will frequently exceed the value of the initial expenditure. A precise mathematical determination of the level at which effort should be expended on the land to improve its productivity cannot be made due to intangible values. The processes of benefit/cost analysis nevertheless *aid* in quantifying specific management programs.[1]

Many factors are involved in assessing the level of management that is justified in a given situation. In addition to the inherent capability of the land, the degree to which this potential is presently being utilized will be significant. The present condition of the land, as this might affect its employment for any specific use, is also important. Of overriding importance in many situations will be the location of the land relative to the markets for goods or services to be provided.

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[1] For a description of the application of benefit/cost analysis, see "A Guide to Benefit-Cost Analysis", Sewell, W.R.D., et al, 1961.

5.011 Intensive Versus Extensive Management. The terms intensive and extensive as applied to land management are purely relative and meaningless without description. The level of application of labour or capital inputs compared to that which can be effectively absorbed by the land determines the intensity of management. Thus, agricultural land of high potential which is fertilized, irigated and cultivated to the level which produces the maximum physical yield of the crop in question may be considered intensively managed. The same land producing a crop of wild plants of limited use to man would be considered to be under extensive management.

Although a given piece of land will produce a greater physical volume of produce from increased inputs, it does not follow that it is necessarily desirable to provide these inputs, i.e., the intensity of management may exceed that which can be effectively employed. As previously noted, the desirable level of management is determined by physical, cultural and economic factors which must be determined for each area or region before the most desirable level of management can be estimated. As in feasibility rating (Section 3.51) the most desirable level of management may vary with the context in which assessment is made. Quantification in the valuation of inputs and outputs is often difficult if not impossible, hence value judgement and personal assessment may be required in decision making in specific situations.

5.012 The Relationship Between Land Capability and Land Management. In the land inventories used in Ontario[1], each land unit is rated in a system which consists of seven classes. These capability classifications (Section 3.32) indicate the potential of the land to provide goods or services (each unit is ranked for agriculture, timber production, wildlife and recreation). The ranking of land capability in this way is a preliminary step toward land allocation, but land allocation cannot be made solely on the basis of the capability class. Different uses of a given piece of land have different values to society in providing human needs. Accordingly, it is the relative position of supply and demand for a given good or service along with the capability and suitability (Sections 3.32 and 3.33) assessment that must determine land allocation.

Since the production of any good or service from the land is largely based on the economics of the operation, efficiency in the use of resources becomes an important criterion in land allocation. Thus the best land use is that which produces the required goods and services with the least demand on the combined input of land, labour and capital resources.

In a given demand situation, an attempt will usually be made to produce the required goods and services from the land of highest capability available for that purpose. However, in any specific situation, the question may well arise - will it be desirable to manage the land of greater capability more intensively to provide the necessary goods and services, or will it be better to extend the operation over a larger area of land of lower potential? No generally applicable answer to this question can be formulated due to variations in response that may be obtained from different levels of management, depending on the land capability and the use intended. However, in certain types of land use, including agriculture and timber production, there is concrete evidence to suggest that the best use of resources is generally obtained when the land of higher capability is used more intensively rather than the alternative more extensive use of less productive areas.

[1]Canada Land Inventory of A.R.D.A.
Ontario Land Inventory of the Ontario Department of Lands and Forests.

5.013 Limitations in the Level of Management for a Specific Use. A given area having a medium capability for a specific use and being well located relative to markets may justify investments in management. It may be assumed that, within reason, an increase in the level of management will stimulate an increase in output. The question then arises, "at what level of management should the area be operated?"

Two factors of significance are involved in arriving at a solution to this problem. The first is a theoretical one which involves a recognition of the law of diminishing returns; the second is the practical problem of quantifying the value of inputs and outputs.

In theoretical terms, it may be said that increases in input are justified to the point where the value of the increased output realized is just equal to the value of the additional input. It is, however, often difficult to assess the response, in terms of physical output, from increasing levels of input.

Assuming that the output response to a given increase in input can be assessed, there remains the problem of determining the value of inputs and outputs in any specific situation. Intangible and social values and the pressures of custom and personal preference often make it difficult to quantify values of inputs and outputs of human production systems related to land use.

In spite of these limitations in analyzing management problems, it is well to recognize the overall objective of maximizing the contribution of resources to the satisfaction of human needs. Where realistic benefit-cost information is available the optimum level of management can be determined with some reliance.

5.014 Limitations in the Level of Management for Multiple Use. Multiple use of a given area may be thought of as the conscious effort to manage that area for a satisfactory production which involves the use of the land for more than one purpose at any given time or its use for different purposes at different times.

Alternative uses for a specific land area may be entirely incompatible, they may be compatible, or they may be complementary. If the alternative uses are entirely incompatible, a single use of the area may be indicated. An example of this situation can be visualized where an undeveloped area may be suitable as a wilderness park or nature reserve and it might also be suitable for timber production. Obviously these two uses are entirely incompatible and the use of the area as a wilderness park precludes its use for timber production and visa-versa. A graphical presentation of this is shown in Diagram 5.

Compatible uses can be visualized where two or more uses may exist for a specific area but where an increase in one use causes a reduction of benefits from an alternative use. If timber production and certain types of recreational use are considered as compatible uses in this sense it may mean that increased timber production will cause reduction in recreational benefits and a situation can be imagined where the gain in benefits from one use is offset by an equal reduction in the benefits from the alternative use. This situation may be shown graphically as in Diagram 6.

[1]For a discussion of these ideas see "Multiple Use of Forest and Related Lands", Forestry Study Unit, Ontario Department of Lands and Forests, 1966.

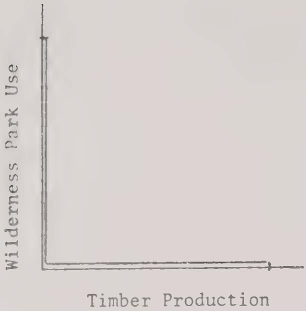

Diagram 5

Incompatible Uses

In this situation the area may be used for either purpose but they are mutually exclusive uses.

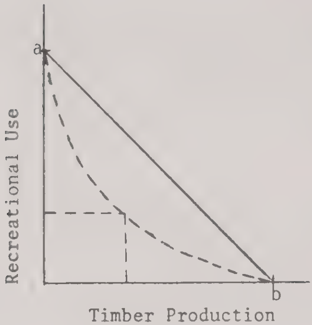

Diagram 6

Compatible Uses

Any combination of uses in this situation (straight line ab) will be equal to the exclusive use for one purpose, i.e. the loss in one use will be made up by a gain in the other use. The concave curve (ab) shows the relationship between uses where the integrated use is less than either of the single uses exclusively.

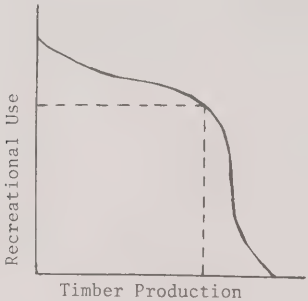

Diagram 7

Complementary Uses

Where uses complement one another, the combined uses provide greater returns than those which would be recovered from either single use exclusively.

Complementary uses could include timber production and certain types of recreational use. The complementary aspects include such things as forest harvesting which increases the game-carrying capacity of the area, and therefore increases its potential for recreational purposes for both viewing and hunting. The increased accessibility provided by roads used for recreation purposes may reduce the costs of harvesting and thereby increase the economic potential of the area for timber production. The graphic representation of this situation is shown in Diagram 7.

Diminishing returns as a factor in management is evident in multiple use management as well as single use as described in the previous section. However, if complementary uses of the land are possible so that fixed costs of development such as roads, may be charged to more than one use, the opportunity exists for multiple use which will be more intensive and more efficient than any of the component single uses could be.

It may be assumed therefore that multiple use for complementary uses not only provides an opportunity for development of each use with the same land input but it may make possible the use of the area at a greater intensity for the combined use than would be possible under single purpose management.

5.02 Comparison of Alternative Land Uses Based on Economic Value Attributed to the Land.

The conventional approach to land-use allocation is to make decisions on the basis of the value attributable to the area by competing uses. These values are determined by society's willingness to pay for the goods or services which the area can produce. Other things being equal, the use which indicates the highest net value for the land is the selected use.

However, many of the benefits derived from the use of land are not readily quantified; some may be considered intangibles and others are not marketed in the conventional meaning of the term. For this reason, present economic analyses based on tangible benefits have definite limitations in determining the level of management of land for any specific use and, by the same token, they have limited usefulness as the basis for land allocation. There is need for greater sophistication in benefit/cost analysis so that social as well as financial factors may be given adequate representation.

The scientific approach to land-use decisions is through that form of economic analysis which deals with the whole sphere of public welfare. Every effort should be made to provide quantified data of increasing reliability as a basis for such analyses. Nevertheless, many decisions will be greatly influenced by value judgement and experience.

5.1 PRESENT MANAGEMENT PRACTICES IN TERMS OF THE DEGREE TO WHICH THE POTENTIAL IS BEING UTILIZED IN THE SIMCOE REGION

Present land use in any specific geographical area is determined by many factors. These include the capability of the land itself for different uses, the orientation of past and present owners respecting land use, markets for the products that may be produced, trade policies, subsidy policies, the socio-economic structure of society as this may be felt on the land in question and other factors of less general significance.

The range of influences that determines the nature of the land use in a specific case and the level of management in that use are very broad. It is evident, therefore, that an assessment of present production in terms of the land potential will be an oversimplification which may ignore many factors that could have an important bearing on the degree to which the land potential is being realized.

In addition to these fundamental difficulties, the nature of presentation of the E.L.U.P. Course provided relatively little time for field examination of conditions. Examples of various land uses and of the relationship between potential production and actual production could be examined but no regional survey of conditions in this respect was possible. The examples, therefore, serve to illustrate conditions that were observed but it cannot be inferred that the same conditions apply over the entire Simcoe Region. Information in a form suitable for general assessment of the region respecting certain uses was scanty necessitating this limited approach.

5.11 The Multiple-Use Management of Land

The increasing trend toward urban living, the development of population concentrations in Southern Ontario, the greater disposable income of the population and the increase in leisure time of most of the people, result in increased pressure for recreational use of those lands close to major concentrations of population. The Simcoe Region falls within the range of many large centres in Canada and the United States and is therefore under increasing pressure for recreational use. At the same time the demand for water, food and for wood products is also increasing and much of the Region is well suited by quality and location to produce these products effectively.

In these circumstances it seems evident that a multiple-use approach to land management is essential if the land is to make its greatest contribution to society.

The traditional approach to land use in Canada has, in the past, been to single purpose use. With a small population spread braodly over the land in towns and small cities, land was abundant and single purpose use was acceptable. Under the changed conditions as they relate to the Simcoe Region, the traditional approach must give way. As with any tradition, however, changes are usually slow and conflicts result in the face of rapidly developing pressure. These conflicts are evident through the rapid increase in land price. Much of this land is being purchased for private recreational use; the limited availability of suitable public lands in the area and single use approach on most areas may be partly responsible for this demand.

It must be recognized that many uses are incompatible so that not all lands are suited by quality or present use to be considered for multiple-use management. Intensive agriculture, for instance, cannot be integrated effectively with most forms of intensive outdoor recreation. However, even in this instance where the uses are separated in time, i.e., summer use for agriculture and winter use for recreation, integration may be feasible. In other cases, uses may be complementary and may mutually benefit one another as in the case of hardwood timber production and wildlife.

Throughout the study area there is little evidence of a conscious effort to integrate the various uses to which most of the lands could be put. The Provincial Government and private land owners could usefully promote the integration of uses in this area of high pressure on land. Education and professional and financial assistance are needed if the most effective integrated use of land is to be attained.

5.12 The Management of Land for Agriculture

There are many factors in addition to the basic capability of the land to produce which determine the extent to which the productive capacity of farm land is realized. Researchers in this area have identified farm size, age and skill of the farm operator, location of the farm relative to markets and the nature and extent of subsidies applicable to farm produce as some of the more important factors.

Any factor which restricts the income from the farm such as farm size, productive capacity of the land or markets, tends also to restrict the input which the operator can apply to his land to realize its economic potential. With respect to land capability a study by MacGregor and Braithwaite (1963) suggests that land of class 3 or lower (in a seven-class rating) for agriculture appears to be marginal for agricultural purposes in Eastern Ontario. Noble (1965) in a study of a 'dairy general' type of farming operation established a significant relationship between (a) a farm classification based on farm size and land capability, and (b) gross annual farm income. The statistics do not conclusively prove that the land capability was recovered more effectively in the larger farms of better land capability but the inference is that such is the case.

Aside from statistical data which suggest that much farm land is managed in such a manner that it is impossible to recover its economic capability, there is the non-quantitative evidence which is apparent from observation in the field which substantiates this conclusion.

A brief description of examples of conditions that exist will serve to demonstrate that the level of management of much of the land used for agriculture leaves something to be desired.

It must first be understood that a more intensive level of management in any given situation is not necessarily desirable. For instance, throughout most of the study area there are properties that have been cleared for agriculture which do not produce crops at an adequate level to support the farm operator and his family; these lands are being sold for recreational use or as part of larger farm units that may be used as range land. In such cases as this, it is evident that an attempt was made in the past to apply a level of management that could not be absorbed effectively by the land due to its low level of agricultural capability.

At the other end of the scale of capability, where potential is high, there are numerous examples of farm units which are so small that the operator is unable to acquire the equipment and materials needed to effectively manage the area. The capability of the area, which in this case would justify a high level of input, is not therefore recovered.

While it is appreciated that generalizations may lead to erroneous conclusions when applied to specific situations, it may nevertheless be useful to recognize the principal management problems in the use of agricultural land in the study area. Because of changes in technology that have not been matched by changes in land distribution among operators or because of failure by operators to adopt extant technology much of the land in use for agriculture is returning to the owners much less than the rated capability of the land. In general the land of higher agricultural use capability rating is being managed with insufficient input and much of the land of lower capability ratings is receiving inputs which it cannot effectively absorb.

Within the study area, in the 25 years from 1941 to 1966, almost 61,000 acres of land used for agriculture in 1941 went out of this use. This amounts to about 2,400 acres per year on the average. For a total 1941 acreage of farm land of 542,000 acres, the shift in use over the 25-year period amounted to about 11 percent. It is evident from an examination of the region that a greater shift away from agriculture to alternative uses is indicated in the future. Part of this is adjustment necessitated by the quality and distribution of the land itself considered in the perspective of an agricultural economy and part by the pressure of competing uses which in many cases attribute to the land values which exceed those recoverable from the present level of agricultural use.

5.13 The Management of Land for Timber Production

Within the study area there are numerous examples of the two principal forest crops that may be considered typical of south central Ontario. These are the (a) tolerant hardwoods usually occurring as naturally regenerated woodlands and (b) softwoods that have been developed in plantations. The natural hardwood forests include a wide range of species of which hard maple is the most common and, with a very few notable exceptions, the most valuable. In the softwood plantations relatively few species are used of which red pine is the most popular and the most valuable. In addition to the forest crops indicated above, which are grown to tree size for the wood-using industries, some land is used for the production of Christmas trees. These generally produce a higher return from the land than does the production of commercial timber crops.

Compared to agricultural crops timber crops require a small input in crop establishment, cultivation and protection. The naturally established hardwoods which can be expected to regenerate on cut-over forest land and abandoned agricultural land may require virtually no investment for either regeneration or protection except fencing against cattle. By comparison, softwood plantations call for an initial investment for planting and normally require, for a number of years, protection against grazing and fire.

The volume yield of the natural hardwood forests is typically less than that of the softwood plantations. The value per unit volume of the hardwoods is highly variable even for trees of the same species and size due to variations in quality. In managed older hardwood lands where small and defective trees have been removed at younger ages, the trees may be of great value - over $1,000 per acre under the best conditions. However, if the largest and best quality trees are removed as they come to merchantable size so that defective trees remain for the final cut, the value per unit of volume may be so low that the timber is commercially inoperable.

The softwood plantation wood rarely if ever attains the value per unit of volume of the best hardwood. However, no portion of the merchantable volume of the plantations will be of as low value as the poor hardwoods.

In the study area much of the forested land is producing hardwoods under methods of management that yield, in quality terms, far less than the land capability for hardwood under optimum management. On the other hand, the plantations, most of which were established at a satisfactory density, will yield virtually the full capability of the land for the species in question. Within the study area it may therefore be assumed that, generally, the use of land for plantations represents a more intensive use than the use of the same area for hardwoods where economic returns from timber production is the objective of management. Also, since the plantations require a higher input than the hardwoods, it follows that the plantations should have been placed on the forest lands best suited to conifer production leaving the less desirable lands to the less intensive hardwood production.

The establishment of plantations in the past was often for the purpose of halting wind erosion or rehabilitating lands not suited to agricultural use; often the production of timber was incidental. Accordingly, when assessed in terms of timber yield, the forests of the region are far from ideally located or managed. Generally speaking the best land available for timber production is producing hardwoods of low quality and is therefore not the most intensively managed. Land of lower timber use capability is frequently intensively managed for plantations. As in agriculture, some shift in emphasis in land management for timber production may be beneficial.

A comparison of agricultural use with timber use indicates that commercial agricultural use is almost without exception a more intensive use of the land than is timber production. Accordingly, other things being equal the lands of higher use capability for agriculture should be alloted to that use regardless of their use capability rating for timber production. The better land available for timber production should be in conifer plantations or in hardwoods under intensive management and the poorer land in the less intensively managed natural hardwood forest.

5.14 The Management of Land for Wildlife and Fish Production

As a primary use of land, wildlife is relatively unimportant in the study area, although it may make a significant contribution to the overall economic status of the region as a secondary use with agriculture or timber production as primary uses.

Wildlife in the region are classified as farmland, forest land or marshland wildlife. Since each of these classes represent a different problem of management it is useful to identify these three groups and deal with each separately; fish management will be added as a part of this section.

(a) Farmland wildlife consists principally of mammals and birds which may be either directly beneficial to the farm operation or a nuisance. The wildlife which contributes to the farm operation includes that which provides value for viewing or hunting such as game birds and rabbits. The wildlife having a directly negative effect on the farm operation includes such birds as blackbirds or starlings which damage agricultural crops, and mammals such as ground hogs which may also damage crops or present other problems. In this discussion we are primarily concerned with the wildlife that contributes to the value of the farm operation due to its value for hunting or viewing.

Farmland wildlife requires a certain area of undeveloped land such as fencerows or woodlots in which the young can be reared and which should provide shelter and some plants suitable for food. In providing such areas, the farm operator may have to make some sacrifice either through maintaining hedgerows or resisting the temptation to drain swamps for agricultural use. Because of its secondary position in land use allocation, the farmland wildlife does not get much consideration and a good deal of the area would support a much higher game population if even minimal efforts were made by farm operators to provide suitable habitat.

Since the farmland wildlife is normally in a secondary position, the capability of the land for wildlife production has relatively little significance in planning the allocation of land.

(b) Forest-land wildlife includes birds and mammals including game birds and deer, both of which have particular value for viewing and hunting.

In the management of land for this wildlife it is evident that variations in conditions especially the presence of open space mixed with forest cover and of various ages of forest cover contribute to the carrying capacity of the land. A regular pattern of timber harvesting is therefore beneficial in increasing the population of certain species of wildlife. In certain areas under management for recreational purposes, it may be desirable to initiate programs designed specifically to increase some particular species of wildlife. Such procedures will not usually be incompatible with the primary use which will determine the overall management procedures to be adopted.

As in the case of the farmland wildlife, there is little evidence that measures have been taken purposely to improve conditions for the forest wildlife. However, the regular cutting of the woodlots for forest products inadvertently produces conditions that favour certain wildlife species.

(c) Marshland wildlife consists of birds and mammals, many of which have considerable value in both consumptive and non-consumptive uses of the land. The principal species in the consumptive area include game birds such as ducks and geese and fur-bearing animals including beaver and muskrat. In the Simcoe Region the direct and indirect benefits provided by game birds and other birds of interest for viewing exceed those of the mammals. As population pressures increase it is probable that the values contributed by the marshland wildlife population will be greatly augmented. For this reason the reservation of suitable areas for marshland wildlife and the management of the areas to increase their carrying capacity is desirable.

Good management of marshland to promote its wildlife carrying capacity may require water level control and the introduction or elimination of certain types of vegetation. These adjustments, in the interests of management, may involve considerable change in the status of the land and the uses to which it may be put. Accordingly, if a number of private owners share the area involved, complications respecting its management may well arise. For this reason management of marshland for wildlife production will be simplified if the area is in public ownership or if it is under one private owner.

In the Simcoe Region certain areas such as Tiny Marsh have been taken under management by the Ontario Department of Lands and Forests with a view to increasing wildlife production and thereby providing additional hunting opportunities. An extension of this program to other suitable lands in the Simcoe Region would appear to be justified in view of the limited public hunting areas in the southern Ontario region generally.

(d) Fish habitat occurs in the study area in the form of a few small lakes (the large lakes bordering the area have not been included in this analysis) and numerous small rivers and streams.

The lakes are not well suited to sport fishing and are of no use for commercial fishing. They are generally shallow and are associated either directly with Provincial Parks or they are located close to larger towns or cities and are intensively used for purposes of water oriented recreation.

The streams however offer a far greater potential, although little of this is utilized. The quality of the water in the streams covers a broad range from the cold, clear, spring-fed Coldwater River to the warmer, murky, but more productive streams such as Nottawasaga. Depending on water temperature and water quality, these streams will produce speckled and brown trout, pickerel and other game fish. At present, however, virtually nothing is being done to encourage fish production. In some cases, such as the Coldwater River, where it flows through forested land, little is required to improve the habitat for fish. However, on most of the streams, an increase in stream bank vegetation would lower the summer temperature of the water and improve the habitat for most game fish. In addition, structures designed to provide underwater shelter for the fish would increase the carrying capacity of many of the streams.

Since most of the streams are on private land much of which is posted, the opportunity for public use of the water for fishing is limited and many of the private owners have little interest in fishing. Accordingly, the potential for game fish production is used to a very limited extent. Because of the widespread public interest in fishing and the limited availability of suitable fish habitat in Southern Ontario, it appears that some action should be taken by the Provincial Government to make possible the more complete use of the game fishing potential of the study area.

5.15 The Management of Land for Recreational Use

Intensive recreation activities are those which take place in a relatively centralized area that has been developed for that use. Activities in this class include camping, swimming, boating, picnicking and skiing. In contrast, such activities as hiking, fishing, hunting and snowmobiling involve the extensive use of large areas and a minimum of development is required.

As noted elsewhere in this publication, the E.L.U.P. course did not involve a statistical survey of the study area for any use. Hence only general comments respecting the development for intensive use activities can be made.

5.151 Camping. Camping facilities are described in terms of camping units; a unit is an area that has been developed to accommodate a group of up to eight people. The camping unit is designed to provide adequate space for the campers' activities and facilities which include provision for water, fire and sanitation. These facilities may be provided in various degrees of elaboration but they usually involve considerable developmental investment if complete facilities are provided.

Campgrounds in the study area are normally associated with a body of water and until recently were mainly provided by the Provincial Government as part of Provincial park developments on Lake Simcoe, Georgian Bay or the small lakes in the area. Since 1958 the number of campsites developed by private interests has increased rapidly in Ontario; there is presently a greater number of private than provincial campsites in the Province. Although statistics are not available for the study area, there is evidence that campsites developed by private interests are on the increase.

Sites for campgrounds require, in addition to water-based recreational facilities, a reasonably level, well-drained area with water for domestic use available on the site or within easy reach. Forest cover is frequently sought as a feature of the site.

Because of the limited area of water in the form of small lakes in the study area, most campground development has taken place on Lake Simcoe or Georgian Bay. The best sites on these lakes have either already been developed for Provincial parks or they are in private ownership. Future development of campgrounds is therefore likely to be expensive due to the cost of land acquisition. There are as yet many areas well suited as far as site characteristics are concerned that could be developed when pressure for campground space justifies the costs involved.

5.152 Picknicking. Picnic grounds require less elaborate facilities than campgrounds and are not necessarily associated with water-oriented recreational facilities, although they frequently are. In the study area most of the picnic grounds have been developed in the Provincial parks at Government expense. There seems little likelihood of extensive development of these facilities by private capital.

Site requirements are much the same as those for camping and the availability of suitable sites in the study area is subject to much the same conditions as that for camping.

5.153 Swimming. It is estimated that by the year 2000 swimming will be the most popular of the outdoor recreation activities. However, where swimming is the only activity studies show that people do not travel more than five miles to go swimming. Swimming therefore should be developed locally or tied in to other activities including picnicking, camping and cottaging.

The small lakes in the study area and the shore area of Lake Simcoe and Georgian Bay have extensive beaches, many of which are ideally suited for swimming and bathing. They are, however, considerably more than five miles from the major centres of population in Ontario and will serve the population effectively only if picnicking and camping facilities are developed in conjunction with suitable swimming and bathing sites. The development of swimming areas for intensive use involves more elaborate facilities than either camping or picnicking since, in addition to sanitation, drinking and parking facilities required for the latter, it is necessary to provide change-rooms and to guarantee user safety.

Conditions for the development of swimming sites in the study area are much the same as those for camping and picnicking.

5.154 Boating. To maintain control over this activity and to avoid damage to vegetation and shoreline conditions, it is advisable to provide at least minimum facilities at suitable locations. These facilities include a boat-launching ramp, parking space and sanitary facilities. Boating is usually associated with such activities as picnicking, camping and swimming, but on the larger lakes these activities may be undertaken on undeveloped sites which may be reached by boat. For this reason, boating is not tied in so closely to camping and picnicking as is swimming and is not limited to sites with fairly rigid quality specifications as the latter group.

Unlike camping and picnicking facilities which are frequently provided by the Provincial Government, the boating facilities are usually provided by private capital. These include boat storage, repair facilities, fuel, and a launching ramp.

Although the small internal lakes of the study area offer limited opportunity for boating due to their size, the larger lakes bordering the study area offer almost unlimited potential. Although considerable use is made of the boating opportunities in the area, much greater use could be made of the larger lakes and rivers.

5.155 Skiing. Some of the best skiing in Ontario has been developed within the study area by private capital for profit and by private clubs.

The essential conditions for the development of attractive skiing facilities include satisfactory topographic conditions which produce long steep slopes preferably facing away from the warmest sun condition, i.e., not south or southwest, snowfall conditions that provide adequate cover from December to March and geographically located within a day-use or weekend-use distance from large centres of population.

There are many sites that have already been developed within the study area that meet all or at least most of these requirements. There are many additional sites somewhat less desirable than the best that have so far been developed, but nevertheless, quite suitable for development considering the increasing demand for these facilities.

Chapter 6

SOME BASIC CONCEPTS OF LAND EVALUATION AND THEIR APPLICATION TO THE SIMCOE REGION

6.0 LAND EVALUATION: SOME BASIC CONCEPTS APPLIED TO THE SIMCOE REGION

In Chapter 4 the natural and cultural features of the Simcoe Region are discussed to provide a background for this more detailed appraisal of the potential and present state of development of the land resources of the region.

The short period and meagre resources of this pilot survey did not permit an in-depth study over the entire region. Reference areas were selected and examined to provide benchmarks on which the future production of goods and services could be projected to other areas. From these few benchmarks, capability and suitability maps were drawn on which the scenarios were based.

6.01 Definition and Objectives of Use Capability and Use Suitability Classification

In section 3.32 use capability is defined as "the potential of an area to produce goods and services of various kinds under specific types and intensities of economic and technological controls". In section 3.33 use suitability is defined as relative ability of a specific area in its present condition to produce specific goods and services. The relative degree of suitability is indicated in terms of the potential production of the site as expressed by the capability rating combined with the degree of effort required to overcome the present limitations in order to attain the level expressed by the capability rating. Use capability ratings indicate potential and set up the targets to be reached. Use suitability ratings indicate the relative degree to which the potential has been developed and the type and intensity of effort required to reach the target.

In rating a given area, the limitations for a specific type of production are divided into two classes: (a) those which are imputed in the capability ratings, and (b) those which are not imputed in capability ratings but which are imputed in suitability ratings.

It is also pointed out in Chapter 3 that both the use capability and use suitability classifications provide a means for comparisons within the same land use on different areas at the same or at different times. They do not provide for comparison of different land uses either on the same or on different areas.

6.011 The role of ecological units in capability and suitability evaluations. It would not be possible to establish capability and suitability classes without comprehensive benefit-cost analyses for each specific area were it not for a knowledge of the ecological relationships of significance in determining the response of the area to changes in technology and in the economic climate.

Ecological units are arranged in gradients having ranges in some ecological feature which can be interpreted in terms of limitations in production. Limitations may restrict either crop growth or management operations.

Each gradient is comprised of classes expressing levels of limitations from a specific point of view. Benchmark sites are selected from classes within a number of such gradients. The benchmark site is then assigned an ordinal rating. This can be done only by value judgment since biological production is the resultant of the processes of the entire system and not that of any discrete part. The classes so formed provide a useful basis for feasibility analyses from which recommended uses are derived.

6.02 The Establishment of Benchmark Sites

Comparative ratings of capability and suitability are made possible through the recognition of sites which are ecologically equivalent for such production factors as moisture supply, nutrient supply, amenability to drainage and to erosion control. This knowledge of ecological equivalents makes possible comparisons with sites other than that on which the rating was determined.

In making such comparisons, not only must the physiography of the sites be equivalent, but both sites must be in the same site condition during the production period and both must have received the same management practice or other conditioning.

Therefore, to be meaningful in land-use planning, standard economic and technological reference conditions must be established and stated as part of the rating. Usually the most efficient methods known or that can be safely projected are taken as the standard reference level.

Although capability ratings are assigned to areal units which are physiographically homogenous, the groupings of the areas into classes is not made on the basis of this homogeneity but on the basis of anticipated output-input ratios after the area has been brought into the specified 'state of production'. The fact that the area is not presently in that state of production does not affect its capability rating. For example, in rating for agricultural use[1], soil catenas whose members differ only in drainage condition may be placed in the same capability class on the assumption that once the drainage has been improved on poorly drained sites these areas will produce at the same benefit-cost ratio as their well-drained counterparts.

6.021 Capability classes and subclasses. In the interpretation of ecological units in terms of comparative production potential, the first step is to establish limitation gradients for a site region. The entire range of potential within any region is divided into seven classes based on the degree of limitation to the production of goods and services, as follows:

	Capability Class		Degree of
Perspective:	Site Region	Ontario	Limitation
	A	1	nil or very low
	B	2	low
	C	3	moderately low
	D	4	moderate

...cont'd

[1]See section 6.13 for a discussion of drainage as a limitation in rating for agricultural use capability.

Perspective:	Capability Class Site Region	Ontario	Degree of Limitation
	E	5	moderately high
	F	6	high
	G	7	very high and extremely high

The next step is to determine the highest level of production for each of the physiographic site types which are included in each of the seven classes. This identification of the physiographic site as a reference is essential since present production is not necessarily the potential production.

Areas of physiographic homogeneity are selected as the 'capability mapping units' because of their relative stability (section 2.03). Although these benchmarks are recognized by their physiography, they are actually ecological units since ecological relationships and not physiography *per se* are the criteria for recognizing each individual unit. These are grouped into capability classes under a specified economic climate and level of technology.

Grouping of areas with equivalent production potential results in considerable physiographic variation within the class. For example, the two main components of the lowest timber capability class (G or 7) are usually of the two physiographic extremes, *viz.*, bare bedrock ridges and open marshland. If these units were being rated for wildlife, they would not be placed in the same class. The marsh area might have an A rating for waterfowl and bare rock ridge a rating of G for upland game.

Another example of this situation involves areas classified as agricultural capability Class 5 which may consist of three groups, each of which has a different type of drainage limitation, namely: (a) excess of moisture, (b) deficiency of moisture, and (c) variability of moisture either within the soil profile or over short distances.

The above examples indicate the way in which capability classes indicating *degree* of limitation are broken into capability subclasses according to the *kind* of limitation. The subclasses have greater ecological homogeneity than the classes. Although the areal units are recognized by their physiography and interpreted in terms of their ecology, they are placed into subgroups and groups depending upon the type and intensity of technological operations which will be involved to obtain potential production.

6.022 Technological benchmarks. These benchmarks are recognized and defined by ecological and technological characteristics but the limits of the classes are determined by value judgments on a broad economic basis.

An examination of the range of production on the same physiographic site type indicates differences in production due to differences in management practices and suggests the need for the first set of technological benchmarks.

(a) Benchmark 1. The establishment of benchmarks indicating the kind and intensity of land management required to attain the highest observed or

interpolated[1] production for specific land uses for each of the commonly occurring groups of physiographic sites within each capability (limitation) class.

From this the need for a second set of benchmarks can be seen.

(b) Benchmark 2. The establishment of benchmark sites to show the variations in response of specific crops under specific management practices.

In order to avoid the complications which arise when benefit-cost analyses are applied at this level of generalization, the response is measured in physical terms of quantity and quality of crop and the input is measured in degree of effort. This avoids the complications of variations in prices from place to place and from time to time. However, such types of comparison are limited to those dealing with the same type of crop and the same type of management. For many comparisons, it is necessary to establish a 'price' which remains constant throughout a region.

In conducting such an analysis it becomes evident that there are inputs which improve the productive capacity of the land and need not be repeated every year. Such inputs must be regarded as part of land cost and not the inputs of effort which are required to produce the crop; these inputs are not part of the 'capability' analysis. This suggests a third set of benchmarks.

(c) Benchmark 3. The establishment of benchmark sites to indicate the type and range in intensity of limitations which can be normally included as part of land costs. These are limitations which are 'non-imputed' in the determination of levels of capability, but are 'imputed' in the determination of suitability. The basis for non-imputing for capability rating is that when this specific limitation is overcome, the land will produce on a benefit-cost ratio which will justify such an increase in 'land cost'. However, if production is limited by more than one non-imputable limitation, the prospective production may be much lower and hence a much narrower range of imputable limitations can be accommodated.

6.03 Selected Reference Areas

Many of the principles involved in land evaluation cannot be fully understood and therefore not adequately presented without having been related first to the actual phenomena of the reference area.

Four reference areas have been selected from the ten reference areas investigated during the two summer sessions. Maps providing the basic physiographic description, present cover types and capability ratings for various uses are included in this chapter.

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[1] The use of superimposed gradients in both site classification and evaluation makes interpolation possible after a reasonable number of benchmarks have been established.

6.1 EVALUATION OF LAND FOR AGRICULTURAL PRODUCTION

6.11 A Regional Summary of Land Capability for Agriculture

In general, the combination of soil and climate of the Simcoe Region produces a high potential for biological production, averaging Class 2 in a provincial scale of seven classes. However, if features such as steepness of slope, erodibility, extreme stoniness or shallowness to bedrock and extreme openness of soil materials are considered, the average ranking of the region falls to third place in the Ontario scale. More significant, however, is the fact that over one-quarter of the region rates Class 2 or better considering the supra-farm type of development discussed below.

The ability of the individual farmer to carry out the required improvements has been used as the basis in most classifications of land for agricultural capability. However, the objective of any improvement is to provide a sound economy for agricultural production at both the farm and community levels and many improvement programs can be carried out effectively only at the community level. The soundness of such projects, however, is dependent upon the ability of the farmers, collectively, to pay the cost unless society as a whole assumes part of it.

Since there is a difference in the level of improvement between that which can be attained by the individual farmer and that which community efforts make possible, it is important that the perspective used in establishing benchmarks be clearly stated and carefully applied.

6.12 The ARDA Method of Classifying Soil Capability for Agriculture

In the ARDA classification the mineral soils are grouped into seven classes on the basis of soil survey information. The soil series (phase where mapped) is the areal unit used for designation of classes on published maps. Areas of soil series are sampled and the ratings of these are applied to the series generally. "Land requiring improvements that can be made economically by the farmer himself is classed according to its limitation or hazards *after* the improvements have been made."[1] These include clearing, draining, stoning and fertilizing. "Land requiring improvement beyond the means of the farmer himself is classed according to its present condition."[1]

A problem associated with the use of the soil series as a basis for capability rating is illustrated by the fact that although the production of some Brookston clay areas is equal to and higher than its better drained soil associates, namely Huron and Perth clay, ARDA classifiers place all Brookston soils in Class 2 because of the higher costs of maintaining the drainage systems while Huron and Perth clay are Class 1. In many cases production on Brookston soils equals that of Class 1 even when costs of maintaining drainage are included in the inputs. This suggests that drainable Brookston soils should be in Class 1 and undrainable Brookston soils in Class 6, their only agricultural use being the production of marsh hay.

[1] Quotations from Legend on ARDA maps.

For details of definition of ARDA classes based on intensity and kind of limitation see legend on ARDA maps of soil capability for agriculture.

6.13 Scheme for Imputing Agricultural Use Capability at Supra-Farm Levels

The ARDA rating of soil capability for agriculture has been established on the basis of "improvements that can be made economically by the individual farmer". However, there are large areas in Ontario (e.g., Essex and Kent Counties) which are rated Class 2 by this system. The individual land owners in these areas could not possibly have installed the drainage dykes which make Class 2 production possible. Not only has community effort been necessary, but in many cases, area drainage has been subsidized by provincial grants. Therefore, a 'supra-farm' reference level is needed for evaluating land for planning long-term agricultural development.

This does not mean that all land should be drained for agricultural development at provincial expense regardless of costs. It merely suggests that a broader perspective be used in establishing scales for comparative evaluation. In general, there is too much land requiring drainage and other improvements already under cultivation so that the drainage of undeveloped wet land which has high potential for other uses is not justified. Nor is the drainage of every acre of a highly productive farm desirable. This emphasizes the fact that a capability rating alone should not be taken as a recommendation. It is but a basis on which to consider first suitability and then feasibility. The capability gradients should be so subdivided into classes that meaningful suitability ratings can be related to them.

6.131 Non-imputable limitations to potential production. These are limiting features which are non-imputed and therefore do not lower the capability rating of the land for agricultural production. They may, however, limit the present agricultural production. These do not lower the capability rating of the land because the cost of developing these lands added to their cost of acquisition does not exceed the cost of improved lands having equal potential. In some cases the cost of development can be handled by the individual farmer. In other cases it must be met by the municipality or province.

Some common examples of limitations which are not imputed in capability ratings are:

- Wet soils (which can be drained without dyking and pumping)
- Stony soils
- Infertile soils (which respond to fertilizer or amendments such as lime)
- Dense and compacted soils (which respond to subsoiling treatment).

Many of these features have been used in previous classifications as limitations in the capability scale, having been introduced in order to make the classification more practical by having the potential level more easily attained. However, if the potential level is not placed high enough, the capability rating has to be changed with every stage of land improvement.

Table 3

RELATIVE CAPABILITY OF THE LANDTYPES OF SIMCOE REGION FOR ARABLE AGRICULTURAL PRODUCTION COMPUTED AT SUPRA-FARM LEVELS

Coarse and medium sand	R-RAMA[1]	F-FLINTON	O-ORO	T-TARA	U-UXBRIDGE	Uv-UXBRIDGE		C-CALEDON
dry	Emf Fmfp[2]	Fmf Ftp	Dm Ftp	Dmf Ftp	Dmf Ftp	Elm Ftp		
fresh	Dmf Fmfp	Dfn	Cnf Fpmf	Cmf Fpmf	Cmf F	Cmf		
moist	Df Ffp	Df Fpf	Cfx Ppnf	ffx Fpnf	Lfx	Cfx		
Silty sand and fine sand	A-ANGLESEA	Q-QUEENSBOROUGH	E-ESSA	K-KITCHENER	D-DURHAM	Dv-DURHAM		
dry	Cmf Fpmf	Cmf Fpmt	Bmf Dpm	Bmf Dpm	Bmf Ftp	Cmf Ftp		
fresh	Bmf Fpmf	Bmf Fpmf	A Dpm	A Dpm	A	Bmf		
moist	Bmf Fpmf	Bmf Fpmf	A Dpm	A Dpm	A	Bmf		
Loam		I-INNISVILLE	L-LANARK	S-SIMCOE	W-WELLINGTON	P-PETERBOROUGH	G-GREY	B-BRUCE
		A-Cp	A	A	A	Bld Dldp	Bld	Cld
Fine silt						Y-YORK		
						Clm		
Clay		M-MARA	C-CARLETON	Z-ZIMMERMAN	H-HURON	N-NEWMARKET		
good structured		A	A	A	A	Bdl		
massive		Cdx	Cdx	Cdx	Cdx	Ddlx		

Scale of Rating - No computable limitations A
- Computable limitations B high to G very low

d density
f nutrient deficiency
l lime excess
m moisture deficiency

p very strong
v shallow bedrock
w water excess
x variable moisture
t topography

1 For definition of landtypes R-RAMA, etc. and correlation with soil series, see Table 6.

2 Only commonly occurring classes given.

Otherwise the actual production of the area becomes higher than the potential on which it is rated. Certain aspects of the suitability ratings, namely, degree of effort to overcome these specific limitations, are discussed in Section 6.14.

6.132 Imputable limitations to potential production. These are the existing limitations which are viewed as incapable of being changed under present economic terms of reference. These are the features which determine the intensity of the limitations as expressed by Classes A to G on the regional scale and Classes 1 to 7 on the Ontario scale.

The following features are those which should be considered. Some of these differ only from the preceding in degree of effort required to overcome them.

Excess of water incapable of being drained except through expensive reclamation schemes (map symbol w)

Shallow rooting depth due to bedrock or other impermeable material (map symbol a)

Massive or dense soils (map symbol d)

Excess toxicity or other elements interfering with normal physiology of organisms, e.g., excessive lime (map symbol l)

Variable moisture conditions within the soil profile or otherwise not correctable by tile drainage (map symbol x)

Deficiencies requiring inputs of fertilizer and amendments which are not economical (map symbol f).

Table 3 indicates the relative potential of the landtypes of Simcoe County to facilitate the production of agricultural crops.

6.14 Degree of Effort Classes

The need for degree of effort classes to combine with the use-capability classes established at supra-farm levels has been introduced above. This need can be clearly seen since all the drained and drainable associates within a soil catena (or landtype) are placed in one capability class, thus the means of differentiating between them has shifted from capability to suitability.

The four limiting features formerly recognized under capability which must now be recognized under suitability are:

Drainable water

Removable stones

Amendable nutrient deficiencies

Amendable compaction.

Since the above are not the only features determining suitability, it is proposed to deal with each of these specifically under the degree of effort required to overcome the limitation and bring production up to the level of potential at which it is classified.

Since 'degrees of effort' is basic not only to the suitability scale but has also been the factor upon which capability and suitability have been separated, it is proposed to establish a degree of effort scale which is applicable to the capability-suitability 'syndrome'.

Class		Degree of Effort Classes
Very low	V	Inputs to maintain production on areas presently producing their potential.
Low	L	Increase of inputs over present usually within the economic ability of the progressive farmer.
Moderate	M	Increase of inputs within the economic ability of a corporation, community or region (the limit of the range of suitability within a capability class).
High	H	Required inputs met through provincial or national support.
Extremely high	E	Required inputs exceed feasibility at provincial and national levels.

See Map 6 for the application of the above method to an area examined critically on these points in 1968.

6.2 EVALUATION OF LAND FOR TIMBER PRODUCTION

This is a system for rating the comparative potential of land to produce timber crops.

The procedure followed in establishing timber-use capability classes is similar to that described in section 6.1 for agricultural-use capability classes, keeping in mind the following:

(a) Although forest and agricultural crops are both affected by the same *kinds* of limitations, e.g., deficiencies in moisture, nutrients and soil depth, there is a vast difference in the degree to which any specific level of these limitations causes a decrease in production from that which is maximum for the region.

(b) The long period (50 to 150 years) required to produce timber reduces the amount of money which can be spent economically on land and improvements such as drainage, fertilization and stoning.

(c) The generally lower per annum return from timber production per unit area relative to that of agricultural production does not permit as wide a range of land 'costs' to overcome limitations to be imputed at the suitability level. Thus, timber capability ratings will consider levels of limitations which in the agricultural appraisal are placed at the suitability level.

6.21 Limitations to Timber Production

The features limiting the potential of land to produce timber are:

Limitation	Map Symbol
Moisture deficiency	- m
Moisture excess	- w
Nutrient deficiency	- f
Excess of lime or toxic elements	- e
Shallow soil over impermeable materials	- r
Restrictive permeability	- d
Steep slopes	- t
Climate	- c

6.211 Moisture excess or deficiency as a feature limiting production. Each forest species has a range of moisture to which it is better adapted. However, this moisture optimum differs for the same species in different climatic regions and for different species in the same climatic region.

Inter-regional and intra-regional comparisons are made using any combination of species which are regionally adapted to the specific moisture classes. Thus the highest production within a site region may be found on somewhat dry, fresh, and somewhat moist sites if different combinations of species are used to compute maximum production. However, production rapidly decreases as the extremes in either moisture deficiency or moisture excess are reached.

6.212 Climatic features limiting production. The use of climatic features to differentiate regional differences in timber production must be considered from two points of view, namely,

(a) relative quantitative production (fibre volume)

(b) contrasting types of production; fast-growing conifers (for construction), slow-growing conifers (for paper) and slow-growing hardwoods (for veneer).

6.22 The Ecological Approach to Timber-Use Capability Classification

In the ecological approach used in the Ontario Land Inventory, both production and species composition classes are established on gradients whose extremes are found within a site region. This provides an opportunity for a provincial production scale to be established with classes differing in ecological significance.

In the Canada Land Inventory (A.R.D.A.) only the production classes measured in terms of M.A.I.[1]) are needed for the ARDA ratings. It is possible to differentiate these production classes into ecological subclasses where information on ecological equivalents is available. This is attempted in the ratings of timber capability made by the Ontario Inventory group for publication on ARDA maps.

In the Ontario system, regional climatic limitations and differences are indicated by the site region gradients. In this system a climatic limitation symbol is useful to indicate the effect of differences in local climate on production, e.g., frost pockets.

The subdivision of landtypes into subtypes based on soil structure and origin provides a more useful framework for indicating timber-producing potential.

The effect of compaction which the 'till' subclasses express differs according to the landtype materials. For example, in Table 4 production is increased by compaction found in an Oro till. Conversely in the loams and finer textured soils, compaction and density in structure with accompanying fluctuations in moisture conditions lowers the production potential. The second line in these materials indicates a commonly occurring condition which is lower than the 'normal' benchmark for the landtype.

The capability ratings shown in Table 4 indicate the common ratings rather than averages of sites occurring within the landtypes.

6.23 Evaluation of Suitability of Land for Timber Production

Since practically all the physiographic limitations to timber production are being imputed under 'capability', the main limitations dealt with under suitability are those associated with site conditioning and crop conversion. The latter includes conversion from field pasture and scrubland crops to timber production; also, conversion from one type of forest to another i.e., stand conversion.

One type of such limitations, namely, that of vegetative competition, was included formerly under capability. The most important example of this is the competition which pine receives from tolerant hardwoods, except when plantations are on old fields. The problem is particularly evident on lands too poor to grow good hardwoods and too rich to grow pine without considerable input to control the hardwoods. Formerly these lands were assigned a lower capability rating even though the production was relatively high once the pine was established.

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[1]M.A.I. Mean Annual Increment in cubic feet

Table 4

TIMBER USE CAPABILITY RATINGS OF SOME COMMONLY OCCURRING SITES*
RANGES FOR THE LANDTYPES OF SIMCOE REGION

TEXTURAL CLASS	PETROGRAPHY CLASS							
	Very Low Base	Low Base or Non-Limy	Low Lime	Medium Lime	High Lime	Very High Lime	Dolomite	Very High Dolomite
GRANULAR	R-RAMA	F-FLINTON	O-ORO	T-TARA	U-UXBRIDGE	Uv-UXBRIDGE		
Coarse and medium sand	R^{0-} Efm+	F^{0-} Dfm	$O^{0\pm}$ Cfm	$T^{0\pm}$ Bfm	$U^{0\pm}$ Cfm	$Uv^{0\pm}$ Dfl		
	R^5 D	F^5 C	O^4 B	T^4 B	U^4 B	Uv^4 B		
FINE AND SILTY SAND	A-ANGLESEA	Q-QUEENSBOROUGH	E-ESSA	K-KITCHENER	D-DURHAM	Dv-DURHAM		
	A^{1-} D	Q^{1-} C	E^1 B	K^{1-} A	D^1 -B	Dv^1 Cl		
	A^{5-} C	Q^4 B	E^4 B	K^5 A	D^5 A	Dv^5 B		
LOAM		I-INNISVILLE	L-LANARK	S-SIMCOE	W-WELLINGTON	P-PETERBOROUGH	G-GREY	B-BRUCE
Pore Pattern 3		I^2 B	L^2-A	S^2-A	W^2-B	P^2-Cl	G^2 C	G^2 D
Pore Pattern 4		I^4 C	L^4-C	S^4 Cd	W^4-Pd	P^4-Pdl		
FINE SILT						Y-YORK		
						$Y^{2,3}$ -Dmf		
CLAY		M-MARA	C-CARLETON	Z-ZIMMERMAN	H-HURON	N-NEWMARKET		
Pore Pattern 4		M^2-A	C^3-A	Z^3-A	H^3-A	N^3-Bl		
Pore Pattern 6		M^4-Cdw	C^6 Bdw	Z^6 Bdw	H^6 Cdw	N^6-Cdw		

*Greater variation in production may be found within landtypes than between landtypes due to differences in moisture. The benchmarks refer to moisture regimes common to the landtype.
+ Limitation as listed in section 6.21.

The limitation due to vegetative competition is now taken care of by a fractionated symbol with capability in the numerator and degree of effort in the denominator. For example, the symbol $\frac{\text{1 pine}}{\text{3v}}$ for a Class 1 site for timber production means that a specific area (covered with hard maple saplings) is capable of producing Class 1 pine but requires a moderate degree of effort (3 out of 5) to overcome vegetative competition (v). For an open field having identical physiography the evaluation symbol could be $\frac{\text{1 pine}}{\text{1p}}$. This means that one crop of Class 1 pine can be grown with a very low degree of effort, namely, that of planting and tending (p). A rating for these same two areas for hard maple might be $\frac{\text{1 hard maple}}{\text{1v}}$ and $\frac{\text{1 hard maple}}{\text{2pct}}$. The ratings in the denominator indicate that it takes less effort to develop the hardwood stand than to develop hardwood on the open field through planting (p) and site conditioning (c); this requires time (t), waiting for one rotation of pine which would condition the site for Class 1 hardwood production.

For a fuller list of capability and degree of effort classes, see maps of reference areas.

6.3 EVALUATION OF LAND FOR WILDLIFE PRODUCTION

In the evaluation of Simcoe Region lands, the participants drew heavily from unpublished manuscripts. In 1964, G. A. Hills prepared a 200-page manuscript entitled "Rating Land for Wildlife Use" as a research project prior to the establishment of the Canada and Ontario Land Inventory. In 1968, Mr. R. D. Thomasson, biologist in charge of the Wildlife Section of the Canada Land Inventory (Ontario), prepared a manual entitled "Land Capability for Wildlife Production" using Hills' physiographic framework and tables of habitat ratings. Thomasson's manual interprets habitat potential in terms of specific species, particularly the upland game species. In 1969, N. G. Perret of the Canada Land Inventory (ARDA), Ottawa, prepared an "Outline of the Canadian Land Capability Classification for Wildlife". The main contribution made by this paper is a definition of the capability classes for waterfowl, the phase of inventory for which the Canadian Wildlife Service is responsible for conducting in Ontario. The survey of the other type of wildlife being investigated by the Canada Land Inventory, namely, the ungulates, is being conducted by the Ontario unit under Thomasson who is making a more comprehensive survey of all upland game species. V. E. F. Solmon, Canadian Wildlife Service, Ottawa, in his 1965 paper, proposed a four-class system of rating fresh water for production of sport fish. F. P. Maher of the Fish and Wildlife Branch, Ontario Department of Lands and Forests, in his 1969 paper "The Canada Land Inventory Sport Fish Capability Survey in Ontario", explained the adaptation of Solman's classification which the Ontario Fisheries Inventory Unit has made.

The fact that none of the above papers has been published suggests that these classifications have not been finalized.

6.31 Limitations to the Capability of Land to Produce Upland Wildlife

Thomasson has included the following in his list of limitations of land to produce upland wildlife.

Limitation	Map Symbol
Poor soil moisture--excessive or deficient	M
Snow depth	Q
Soil fertility	F
Exposure or aspect	U
Small size of specific habitat--severe localization of the production of a specific species.	S

In almost every instance these are limitations which cannot be easily remedied and therefore are truly 'capability limitations. The only possible exception is that of soil fertility. It may be possible to fertilize for wildlife production without materially changing the benefit-cost ratio. Since stations at which deer may secure salt and other minerals should prove successful and are not likely to change the range in benefit-cost ratio, some aspects of soil fertility could be imputed as a suitability factor.

6.32 Degree of Effort Classes in Developing the Potential of Land for Wildlife Production

Unsuitable vegetative cover for the wildlife species being rated is the commonest limitation to wildlife production which is imputed as a suitability limitation. This appraisal of cover must be related to specific species or groups of species, such as farmland versus woodland game. A farm cover of soybeans, corn and hay presents no limitations to pheasant production providing there are brushy fencerows but lands with this cover require a moderate to high degree of effort to establish a red deer habitat.

The Ontario committee of the Wildlife Land Inventory was the first (and only) sector to introduce ratings of degrees of effort as part of the symbol of capability inventory maps, doing so at the risk of presenting a cluttered appearance to the maps. This committee considered this to be necessary in the case of wildlife since present cover does not alter the basic capability rating but greatly influences the actual wildlife production. This production cannot be changed without changing the cover. This is often not feasible because of the existing economy of the human community which is usually firmly established.

The following degree of effort classes* are quoted from Thomasson (1968), pages 130-134.

"Class 'A' Present habitat (including soil and vegetation) is suitable for the species concerned. Little or no manipulation is required. e.g., dairy type agricultural areas for

*These are equivalent to the classes 1 to 5 used on Maps 8 and 18.

Hungarian partridge; mature aspen and birch with forest openings for ruffed grouse; brush growth for deer with clearings and conifers for winter cover.

Class 'B' Present habitat is suitable but requires a small amount of manipulation. e.g., breaking a closed canopy by removing mature or overmature trees.

Class 'C' Present habitat is not suitable; a moderate amount of manipulation is required. e.g., establishing permanent pasture in scrub areas--tree stumps will not have to be removed; work can be done with common agricultural implements.

Class 'D' Present habitat is not suitable; a large amount of manipulation is required. e.g., clearing large areas of non-marketable trees by any method and replanting by hand if necessary.

Class 'E' Area requires extensive habitat manipulation. e.g., re-locating soil and establishing cover.

Although not stated by Thomasson, Classes D and E are categories in which the cost dictates that a community or provincial effort to be undertaken to obtain some non-marketable welfare benefit.

Thomasson has not undertaken an analysis of other limitations which could be included on maps under degree of effort, such as the building of small dams in a pot-hole moraine for the creation of ponds for waterfowl production.

6.4 EVALUATION OF LAND FOR OUTDOOR RESOURCE-BASED RECREATION

The evaluation of land for outdoor resource-based recreation is made on the same principles as those used for rating land for agriculture, timber and wildlife production and described in the preceding sections. The features of a land area which limit each specific recreational use must be examined and a decision made as to what type and level of limitation must be imputed as a class within a capability gradient and what ones within a suitability gradient. Ecological gradients are subdivided into classes which are regrouped first into capability ranks and then into suitability ranks within a socio-economic framework.

The use of broad socio-economic values in determining the levels at which the gradients should be broken does not mean that the classes which result

are feasibility ratings. A parallel illustration is the establishment of moisture regime classes within soil moisture gradients using types and levels of biological production as the basis for the subdivision. These classes, identified in terms of soil features, can then be used for detailed comparisons of many different types and levels of production without being productivity classes in themselves.

Similarly, capability and suitability classes provide parameters for the determination of feasibility and recommended use but are not feasibility classes in themselves. Examples will be found in the following discussion of reference areas.

Owing to the many kinds of recreational activities and the many aspects of each of these, the following discussion is by no means comprehensive but merely illustrative of the method of approach.

The objective of establishing levels of capability for recreational land use is to locate and inventory recreational lands in terms of their potential under present economic, social and technological controls.

Since the present production on many of these lands is much less than the potential, it is essential to indicate this. Since it is not possible nor convenient to indicate the inputs in dollars which are required to improve the land to the point at which it produces at the potential level, degrees of effort classes have been established.

6.41 Rating Land Capability for Outdoor Recreation

A few of the several recreational activities have been selected for discussion.

6.411 Capability of land for bathing and camping. One of the most intensive of the recreational land uses is that of beach bathing with the associated activities of sunbathing and camping.

The many features required for these activities have been outlined in the Ontario Recreation Land Inventory Manual. Only a few of these are being selected to illustrate the principles.

(a) Area of wet beach (water less than five feet deep):

The lack of gently sloping shorelines providing large strips of water less than five feet is a limitation which should be considered under 'capability', particularly on the Great Lakes since control of water depth is virtually impossible. Under special circumstances the water levels of smaller lakes may be controlled. In this case low water level is a suitability limitation.

(b) Temperature of water:

Coldness of water, for example, must be imputed as a 'capability' limitation.

(c) Pollution of water:

The organic and mineral pollution of an otherwise satisfactory bathing beach is a limitation imputable at the suitability level indicating the responsibility of society to overcome such limitations.

(d) Wet beach materials:

Wet sand beaches provide a higher quality experience for bathers than do 'till' beaches but do not necessarily have a higher carrying capacity. The question is, "Have till beaches the same capability as the sand beaches but a lower suitability?" The imputing of the limitation of non-sand beaches to suitability would be based on the assumption that a 'sand' covering of the till can be provided at a cost which can be absorbed within a land cost similar to the imputation when good farmland is drained. If we assume that it is not feasible to convert large areas of till beaches to sand beaches, even by community effort, till beaches must have a lower capability class than the sand beaches rather than a lower suitability rating within the same class. The significance of this is that regardless of the inputs invested in the till beach to improve the quality of the bathing experience, the benefit-cost ratio over a long-term period will not be as high as that of the sand beaches, other things being equal.

However, not all limitations of beach materials should be imputed to capability. For example, all beaches with organic soils have been rated Class 6 in the ARDA Inventory because of their present use. However, if the organic layer is shallow over sand (or till), the cost of removing the organic layer need not lower the benefit-cost ratio significantly and the capability rating is that for the underlying material. The shallow organic layer in this case is matter for suitability imputation.

In some classifications the presence of boulders lowers the rating from 1st to 4th class or lower. However, consideration should be given to the materials underlying the boulders and the effort required in removing the stones. The classification of sand beaches which are periodically covered by boulder ridges brought to shore by storms varies according to the interpretation used in dealing with the removal of the boulders. If the benefit derived from the beach is relatively high and the cost of removing the boulders relatively small, the beach may be given a capability rating of 1 with a suitability rating based on a Class 2 or greater effort for removing the boulders. On the other hand, the frequency with which these storms occur and the sustained cost of the removal of stones result in a capability Class 2 or 3 but rarely would it deserve 4th rate. Ingonish Beach in Nova Scotia has this feature and is rated Class 2 not because of the storm beaches but largely because of the cold water.

(e) Backshore for camping and other support areas:

Beach and backshore are evaluated as a package because of the need for 'support areas' when beaches are used intensively. The question is, "Is the lack of support areas a capability limitation or a suitability limitation?" It is considered a capability limitation in the ARDA

classification, e.g., "the extremities of the spits are downgraded one class in view of their distance from development areas"[1], that is, from parking and camping areas.

In order to provide the best camping and parking facilities, the backshore should be level and deep soiled. How should the limitations of shallowness and unevenness of the soils of the backshores be evaluated--as capability or suitability limitations?

Important as these supporting areas are, backshore limitations to high-quality beaches may in some cases be overcome through an initial investment which can be incorporated in the long-term land costs. Therefore, in such cases these are suitability limitations rather than capability limitations.

6.412 Capability of land for skiing. Features, deficiencies of which represent the main limitations for skiing, are as follows:

Vertical drop
Aspect
Snowfall
Variety of slopes
Topography of runs
Stoniness
Depth of soil
Forest cover

Of the above features, vertical drop and aspect are the only ones which cannot be changed to any considerable degree and therefore are capability limitations. Although snowmaking has become common on many ski resorts it is questionable whether deficiency of snowfall is a limitation which can be imputed in a suitability scale.

To some extent at least, variety of slopes and topography of runs can be improved by bulldozing, making the site more suitable and hence of higher capability. In this case the limitation does not lie in the relief *per se* but is also related to the workability of the materials. Loamy hill lands can be readily reshaped and deficiencies in relief may therefore be suitability limitations but the steeply sloping rocklands are capability limitations indeed. The lack of adequate grounds for housing and parking and outrun areas is a suitability limitation.

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[1] Field Manual Land Capability Classification for Outdoor Recreation. Can. Land Inventory, Dept. Forestry & Rural Development, Ottawa. June 1967.

6.5 DESCRIPTION AND EVALUATION OF SOME REPRESENTATIVE REFERENCE AREAS

Four reference areas have been selected to demonstrate the method by which benchmark sites are used to evaluate land areas.

6.50 Reference Areas - The Ecological Laboratory of Inter-Intra Relationships Considered in Land Classification and Evaluation

To obtain the basic ratings needed in land classification, benchmark sites are established which are homogenous with respect to the type of production for which they are being rated. However, the degree to which the basic potential may be utilized is affected by the other intimately associated sites within a use pattern. For example, the degree to which the production of land with a very high potential is reduced by its association with land with a very low potential is dependent on many factors. These include the distribution pattern of each of these types of land, the relative size of the areas of each type in relation to the size and type of the management unit as a whole. Although the ideal approach to setting up farm, forest and wildlife units of management (a farm, a forest compartment, or a wildlife range) cannot be pursued to this level of detail in this presentation, the rating of patterns will be summarized, first at the land-type component level and later at the land unit level. From an intensive study of the reference area and a reconnaissance survey of the land unit as a whole, the degree to which each reference area is representative of its land unit can be determined. In some cases a supplementary reference area may be required to complete the generalized rating for the land unit. The first step in reaching the next level of generalization is to determine the degree to which the land unit rated is representative of the landform pattern.

Although the 1968 team synthesized ratings at various levels of generalization, space in this report does not permit illustration of these findings by maps. A careful comparison of the landform patterns as expressed by the reference area maps and the recommended use recorded on the scenario may provide some indication of the weight given to the ratings established in the reference area during the overall interpretation of the land unit.

Thus, behind the rating of the landform pattern is the representative land unit; behind the land units are the reference areas and behind the reference areas are the benchmark sites. Behind all of these is the skill and judgment of the land-use specialist who must (a) analyse the objectives to be attained, (b) decide upon the kind of benchmarks to be examined, and (c) determine the manner in which these are to be marshalled into a hierarchy of reference areas, land units, landform patterns and eventually into planning units. This marshalling cannot be done by mechanically lining up the physiographic, biological, social and economic factors independently of one another for a computer to integrate mechanically. Each set of features must be prefitted for their integration within the whole. There is no point in establishing classes within physiographic gradients for general farming economy including livestock if the land is to be used for a mono-culture practice such as wheat farming. Likewise capability classes must be established for interpretation within anticipated socio-economic constraints (Section 3.32).

Only a few examples can be given here of the many types of inter-intra relationships at the vertical and areal levels of integration needed for the classification and evaluation of ecosystems.

Table 5

LANDTYPES AND MODAL PHYSIOGRAPHIC SITE TYPES OF SITE REGION 6E

TEXTURAL CLASS	PETROGRAPHY CLASS							
	Very Low Base	Low Base Non-Limy	Low Lime	Medium Lime	High Lime	Very High Lime	High Dolomite	Very High Dolomite
GRANULAR Coarse and medium sand	R-RAMA R_0 " dry R_3 " fresh R_5 " moist R_7 " wet	F-FLINTON F_0 " dry F_3 " fresh F_5 " moist F_7 " wet	O-ORO O_1 " dry O_3 " fresh O_5 " moist O_7 " wet	T-TARA T_1 " dry T_3 " fresh T_5 " moist T_7 " wet	U-UXBRIDGE U_1 " dry U_3 " fresh U_5 " moist U_7 " wet	Uv-UXBRIDGE Uv_1 " dry Uv_3 " fresh Uv_5 " moist Uv_7 " wet		C-CALEDON C_1 " dry C_3 " fresh C_5 " moist C_7 " wet
FINE AND SILTY SAND	A-ANGLESEA A_1 " fresh A_5 " moist A_7 " wet	Q-QUEENSBOROUGH Q_1 " fresh Q_5 " moist Q_7 " wet	E-ESSA E_1 " fresh E_5 " moist E_7 " wet	K-KITCHENER K_1 " fresh K_5 " moist K_7 " wet	D-DURHAM D_1 " fresh D_5 " moist D_7 " wet	Dv-DURHAM Dv_1 " fresh Dv_5 " moist Dv_7 " wet		
LOAM Very fine sand, coarse silt loam, sandy loam		I-INNISVILLE I_2 " fresh I_5 " moist I_7 " wet	L-LANARK L_2 " fresh L_5 " moist L_7 " wet	S-SIMCOE S_2 " fresh S_5 " moist S_7 " wet	W-WELLINGTON W_2 " fresh W_5 " moist W_7 " wet	P-PETERBOROUGH P_2 " fresh P_5 " moist P_7 " wet	G-GREY G_2"fresh G_5"moist G_7"wet	B-BRUCE B_2"fresh B_5"moist B_7"wet
FINE SILT						Y-YORK Y_2 " fresh Y_5 " moist Y_7 " wet		
CLAY Include clay laom		M-MARA M_3 " fresh M_5 " moist M_7 " wet	C-CARLETON C_3 " fresh C_5 " moist C_7 " wet	Z-ZIMMERMAN Z_3 " fresh Z_5 " moist Z_7 " wet	H-HURON H_3 " fresh H_5 " moist H_7 " wet	N-NEWMARKET N_3 " fresh N_5 " moist N_7 " wet		

0,1,3,5,7 soil moisture classes within a regional scale; e.g., R_0, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9.

6.501 Benchmark Sites. Although reference areas were established by the study group to provide benchmark sites for the region, these benchmarks could not have been established at a meaningful level for land-use planning had not regional benchmarks been previously established by regional research (Hills 1960d).

For this systematic coverage, site regions are subdivided into landtypes which in each site regions are recognized by combinations of broad textural classes and petrography of the geological materials (Sections 3.21 and 3.22). The most significant subdivision of the landtype is that of soil moisture regime. The unit resulting is the physiographic site type (Section 3.23). This is a homogenous unit which is the basis for ecological land-use planning. The subdivision of Site Region 6E into landtypes and physiographic site types is shown in Table 5.

In Section 3.6, the difficulty of using the soil series as benchmark sites was discussed. Table 6 shows the range of features which may actually exist in a soil series as mapped in Simcoe County.

Regional site research has been intensively carried on in the Simcoe Region by J.R.M. Williams. The report (Williams 1965)[1] prepared for the meeting of the Eastern Forest Soils Conference in this area has provided much strength to the ratings assigned to the benchmarks in the reference areas described here. Unfortunately the Ontario Department of Lands and Forests has not, to the present, adopted an active program of permanent reference area research although the program of permanent sample plot establishment presently in progress will be helpful in this regard. The sites on which most of these plots are established have been examined and classified by Williams. The work of Love and Williams (1968) provides quantitative expression for classes in portions of production gradients, for example, the gradient which ranges from the best red pine site in the region to the poorest red pine site on which fully stocked stands could be found for measurement. Love and Williams rated the production of sites on the deep sands of the Simcoe Region having a range of moisture regime. In the collection of their data no attempt was made to relate production to variations in the level of management - a superior level of management was assumed throughout. The site classification scheme is so designed that quantitative information relating to production and levels of management can be integrated, as it becomes available, provided the data are stratified according to physiographic site types.

6.502 Method of Obtaining Generalized Scales of Rating. The local areas, which are homogenous with respect to production, are rated A to G on a regional scale. Owing to the variability of land areas which can be shown on maps at scales smaller than 20 chains to the inch, ratings must apply to patterns of homogenous areas rated A to G. The ratings of these patterns may show indices 1 to 9 indicating that 10 to 90 percent of the area is assigned that specific class, e.g., $D^5C^3E^2$ means 50 percent D, 30 percent C, and 20 percent E. Although it is possible to use any or all of the seven classes, it is difficult to compare two or more areas each having a 'string' of ratings. A system (Hills 1961) has been developed which renders a general rating for an areal pattern which recognizes the components of that pattern in the general rating. The first step is to reduce all ratings to a three-letter symbol and to arrange in order of dominance as follows: (a) First letter, mode 50 percent, range 35-79 percent; (b) Second letter, mode 30 percent, range 11-44 percent; (c) Third letter, mode 20 percent, range 10-32 percent.

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[1]Williams, J.R.M. 1965. Field Trip Outline. North Eastern Forest Soils Conference, Research Branch, Ontario Department of Lands and Forests, Maple [unpublished manuscript].

Table 6

LANDTYPES OF SITE REGION 6E CORRELATED WITH SIMCOE COUNTY SOIL SERIES AS MAPPED FOR REPORT NO. 29

TEXTURAL CLASS	PETROGRAPHY CLASS							
	Very Low Base	Low Base or Non-Limy[1]	Low Lime	Medium Lime	High Lime	Very High Lime	High[2] Dolomite	Very High[3] Dolomite
GRANULAR Coarse and medium sand	*R-RAMA* *Tioga* *Alliston* *Granby* *Wyevale* *Hendrie*	*F-FLINTON* *Tioga* *Alliston* *Granby* *Wyevale* *Hendrie*	*O-ORO* *Tioga** *Alliston** *Granby*	*T-TARA* *Tioga* *Burford** *Sargent* *Gwillimbury* *Gilford* *Granby**	*U-UXBRIDGE* *Tioga* *Pontypool* *Sargent* *Gilford* *Caledon* *Burford*	*Uv-UXBRIDGE* *Tioga* *Pontypool** *Sargent** *Gwillimbury* *Eastport*		
FINE AND SILTY SAND	*A-ANGLESEA* *Tioga* *Alliston* *Granby* *Vasey*	*Q-QUEENSBOROUGH* *Tioga* *Alliston* *Granby* *Vasey*	*E-ESSA* *Tioga** *Alliston** *Granby* *Vasey*	*K-KITCHENER* *Pontypool*	*D-DURHAM* *Pontypool* *Percy*	*Dv-DURHAM* *Pontypool*		
LOAM Very fine sand, coarse silt loam, sandy loam, loam		*I-INNISVILLE* *Vasey*	*L-LANARK* *Vasey* *Tioga*	*S-SIMCOE* *Bennington*	*W-WELLINGTON* *Bondhead* *Guerin* *Lyons* *Bennington*	*P-PETERBOROUGH* *Otonabee* *Osprey*	*G-GREY* *Harriston* *Wiarton* *Parkhill*	*B-BRUCE* *Osprey* *Harkaway*
FINE SILT						*Y-YORK* *Schomberg* *Smithfield* *Simcoe*		
CLAY Include clay loam		*M-MARA* *Medonte* *Lovering* *Atherley*	*C-CARLETON* *Medonte* *Lovering* *Atherley*	*Z-ZIMMERMAN* *Medonte* *Lovering* *Atherley* *Dunedin*	*H-HURON* *Medonte* *Lovering* *Atherley* *Dunedin*	*N-NEWMARKET* *Schomberg* *Smithfield* *Simcoe* *Minesing*	*Vincent* *Kemble*	

[1] Non-limy applied to silt and clay.
[2] High lime with moderate dolomite content.
[3] Very high lime with high dolomite content.

*Modal position of Soil Series in Ontario. *Tioga** indicates that the modal Tioga is low in lime.

Table 7

ESTABLISHMENT OF SEVEN USE CAPABILITY RATINGS FROM 343 THREE-POSITION CLASSES

Landtype Patterns Dominantly Class A

←1st rate→ ←2nd rate→

AAA 2900	ABA 2840	ACA 2750	ADA 2630	AEA 2480	AFA 2300	AGA 2060
AAB 2660	ABB 2800	ACB 2710	ADB 2390	AEB 2440	AFB 2260	AGB 2020
AAC 2800	ABC 2740	ACC 2650	ADC 2390	AEC 2380	AFC 2200	ACC 1960
AAD 2720	ABD 2660	ACD 2370	ADD 2450	AED 2300	AFD 2120	AGD 1680
AAE 2620	ABE 2560	ACE 2470	ADE 2350	AEE 2200	AFE 2020	AGE 1780
AAF 2500	ABF 2440	ACF 2350	ADF 2230	AEF 2080	AFF 1900	AGF 1660
AAG 2340	ABG 2280	ACG 2190	ADG 2070	AEG 1920	AFG 1740	AGG 1500

←3rd rate→ ←4th rate→ ←5th rate→

Landtype Patterns Dominantly Class B

1st rate ←2nd rate→ ←3rd rate→

BAA 2800	BBA 2740	BCA 2650	BDA 2550	BEA 2380	BFA 2200	BGA 1960
BAB 2760	BBB 2700	BCB 2610	BDB 2490	BEB 2340	BFB 2160	BGB 1920
BAC 2700	BBC 2640	BCC 2550	BDC 2430	BEC 2280	BFC 2100	BGC 1860
BAD 2620	BBD 2560	BCD 2470	BDD 2350	BED 2200	BFD 2020	BGD 1780
BAE 2520	BBE 2460	BCE 2370	BDE 2250	BEE 2100	BFE 1920	BGE 1650
BAF 2400	BBF 2340	BCF 2250	BDF 2130	BEF 1980	BFF 1800	BGF 1560
BAG 2240	BBG 2180	BCG 2090	BDG 1970	BEG 1820	BFG 1640	BGG 1400

←4th rate→ ←5th rate→

Landtype Patterns Dominantly Class C

←2nd rate→ ←3rd rate→

CAA 2650	CBA 2590	CCA 2500	CDA 2380	CEA 2230	CFA 2030	CGA 1810
CAB 2610	CBB 2550	CCB 2460	CDB 2340	CEB 2190	CFB 1990	CGB 1770
CAC 2550	CBC 2490	CCC 2400	CDC 2280	CEC 2130	CFC 1930	CGC 1710
CAD 2470	CBD 2410	CCD 2320	CDD 2200	CED 2050	CFD 1870	CGD 1630
CAE 2370	CBE 2310	CCE 2220	CDE 2100	CEE 1950	CFE 1770	CGE 1530
CAF 2250	CBF 2190	CCF 2100	CDF 1980	CEF 1810	CFF 1640	CGF 1410
CAG 2090	CBG 2030	CCG 1940	CDG 1820	CEG 1650	CFG 1480	CGG 1250

←4th rate→ ←5th rate→ 6th rate

Landtype Patterns Dominantly Class D

2nd rate ←3rd rate→ ←4th rate→

DAA 2450	DBA 2390	DCA 2300	DDA 2180	DEA 2030	DFA 1850	DGA 1610
DAB 2410	DBB 2350	DCB 2260	DDB 2120	DEB 1970	DFB 1790	DGB 1570
DAC 2350	DBC 2290	DCC 2200	DDC 2080	DEC 1930	DFC 1750	DGC 1510
DAD 2270	DBD 2210	DCD 2120	DDD 2000	DED 1850	DFD 1670	DGD 1430
DAE 2170	DBE 2110	DCE 2020	DDF 1900	DEE 1750	DFE 1570	DGE 1330
DAF 2050	DBF 1990	DCF 2000	DDF 1780	DEF 1620	DFF 1440	DGF 1210
DAG 1890	DBG 1830	DCG 1740	DDG 1620	DEG 1470	DFG 1290	DGG 1050

←5th rate→ ←6th rate→

Landtype Patterns Dominantly Class E

3rd rate ←4th rate→

EAA 2200	EBA 2140	ECA 2050	EDA 1930	EEA 1780	EFA 1600	EGA 1360
EAB 2160	EBB 2100	ECB 2010	EDB 1890	EEB 1740	EFB 1560	EGB 1320
EAC 2100	EBC 2040	ECC 1950	EDC 1830	EEC 1680	EFC 1500	EGC 1260
EAD 2020	EBD 1960	ECD 1870	EDD 1750	EED 1600	EFD 1420	EGD 1180
EAE 1920	EBE 1860	ECE 1770	EDE 1650	EEE 1500	EFE 1320	EGE 1080
EAF 1800	EBF 1740	ECF 1650	EDF 1530	EEF 1380	EFF 1200	EGF 960
EAG 1640	EBG 1580	ECG 1490	EDG 1370	EEG 1220	EFG 1040	EGG 800

←5th rate→ ←6th rate→

Landtype Patterns Dominantly Class F

←4th rate→ ←5th rate→

FAA 1900	FBA 1840	FCA 1750	FDA 1630	FEA 1480	FFA 1300	FGA 1060
FAB 1860	FBB 1800	FCB 1710	FDB 1590	FEB 1440	FFB 1260	FGB 1070
FAC 1800	FBC 1740	FCC 1650	FDC 1530	FEC 1380	FFC 1200	FGC 960
FAD 1720	FBD 1660	FCD 1570	FDD 1450	FED 1300	FFD 1120	FGD 880
FAE 1620	FBE 1560	FCE 1470	FDE 1350	FEE 1200	FFE 1020	FGE 780
FAF 1500	FBF 1440	FCF 1350	FDF 1230	FEF 1080	FFF 900	FGF 660
FAG 1340	FBG 1280	FCG 1190	FDG 1070	FEG 920	FFG 740	FGG 500

←6th rate→ 7th rate

Landtype Patterns Dominantly Class G

←5th rate→

GAA 1500	GBA 1440	GCA 1350	GDA 1230	GEA 1080	GFA 900	GGA 660
GAB 1460	GBB 1400	GCB 1310	GDB 1190	GEB 1040	GFB 860	GGB 620
GAC 1400	GBC 1340	GCC 1230	GDC 1130	GEC 960	GFC 900	GGC 560
GAD 1320	GBD 1260	GCD 1170	GDD 1050	GED 900	GFD 720	GGD 480
GAE 1220	GBE 1160	GCE 1070	GDE 950	GEE 800	GFE 620	GGE 380
GAF 1100	GEF 1040	GCF 950	GDF 830	GEF 680	GFF 500	GGF 260
GAG 940	GBG 880	GCG 790	GDG 670	GEG 520	GFG 340	GGG 100

←6th rate→ ←7th rate→

Note that areas of less than 10 percent may be ignored although usually these are included in another class in the calculation. Where there are less than three classes within an area, the same letter may occupy two or three positions, e.g., AAA (100 percent A), and BAA (50 percent each of B and A).

Upon reducing the rating to a three-letter designation, of which there are 343 classes, there is still the need to discern comparative positions of these within the scale. Furthermore, a grouping of these 343 classes is necessary to reduce the number of classes to seven for such activities as regional planning. These seven generalized classes are designated 1 to 7. Although corresponding to the A to G scale, this scale differs from it in that Class 4 can be either 100 percent D (4th class), a combination of A and G, or other combinations of classes.

Theoretically, 50 percent A and 50 percent G should constitute Class 4. However, an intimate association of poor land such as bare bedrock of Class G for agriculture with good land of Class A so lowers the potential of the latter that it is necessary to consider each class as part of a pattern. A method devised by Hills (1961) weights the effectiveness of the A to G classes within the total pattern in such a way that an area which is 50 percent A and 50 percent G falls into Class 5 and not into the theoretical Class 4. The placement of all of the 343 three-position classes into Class 1 to 7 ratings is shown in Table 7. The resulting numerical position shown underneath each three-letter symbol indicates the position in a scale from 100 to 2900 of each of the 343 combinations when each class is given a weight from Class A-29 to Class G-1. The number is the weighting of each class times the percentage of that class within the combination. For example, DDD is 2000, being the weighting of D, *viz.* 20 times 100, the percentage of D in the combination.

The above discussion describes in general terms the methods used in assessing reference areas selected in the region. Four of these areas are specifically described below.

6.51 Reference Area 1

6.511 Physiography. This reference area was selected to represent the clay and loam portions of the North Nottawasaga Till-capped Clay Plain (Section 4.16). The 50 soil pits and over 100 soil probes made by a 1968 team revealed an astounding variability of strata in what appeared superficially to be a uniform 'lacustrine' clay plain. As shown on Map 4, the texture ranges from coarse sand to clay, and the petrography from non-limy to very high lime. There is no consistency with which these variations occur in the soil cross-section. Sand or clay may be at the surface or at some depth. The implications of this variability as it relates to agricultural production are discussed in Section 6.513.

6.512 Present Cover Types and Present Use. The present cover types are shown on Map 5. The cover types of much of the area indicate a fairly intensive type of agriculture. However, the percentage of corn and legume crops grown is relatively low in view of the agricultural potential of the land.

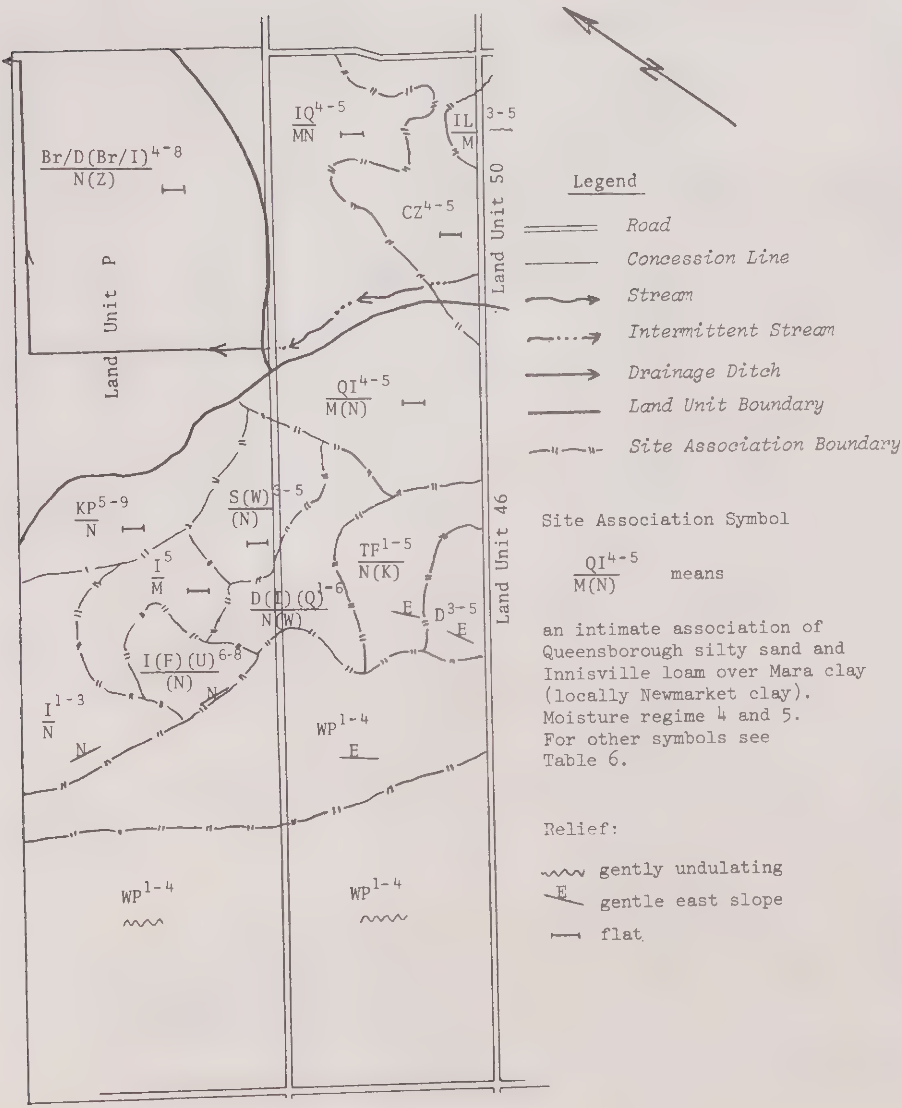
The present cover of the farm lands provide a good habitat for farm wildlife such as Hungarian partridge and European hare. An increase of corn would improve the goose pasture. The tree cover on the wet organic land is too spare for the best protection of deer.

Map 4 Reference Area No. 1

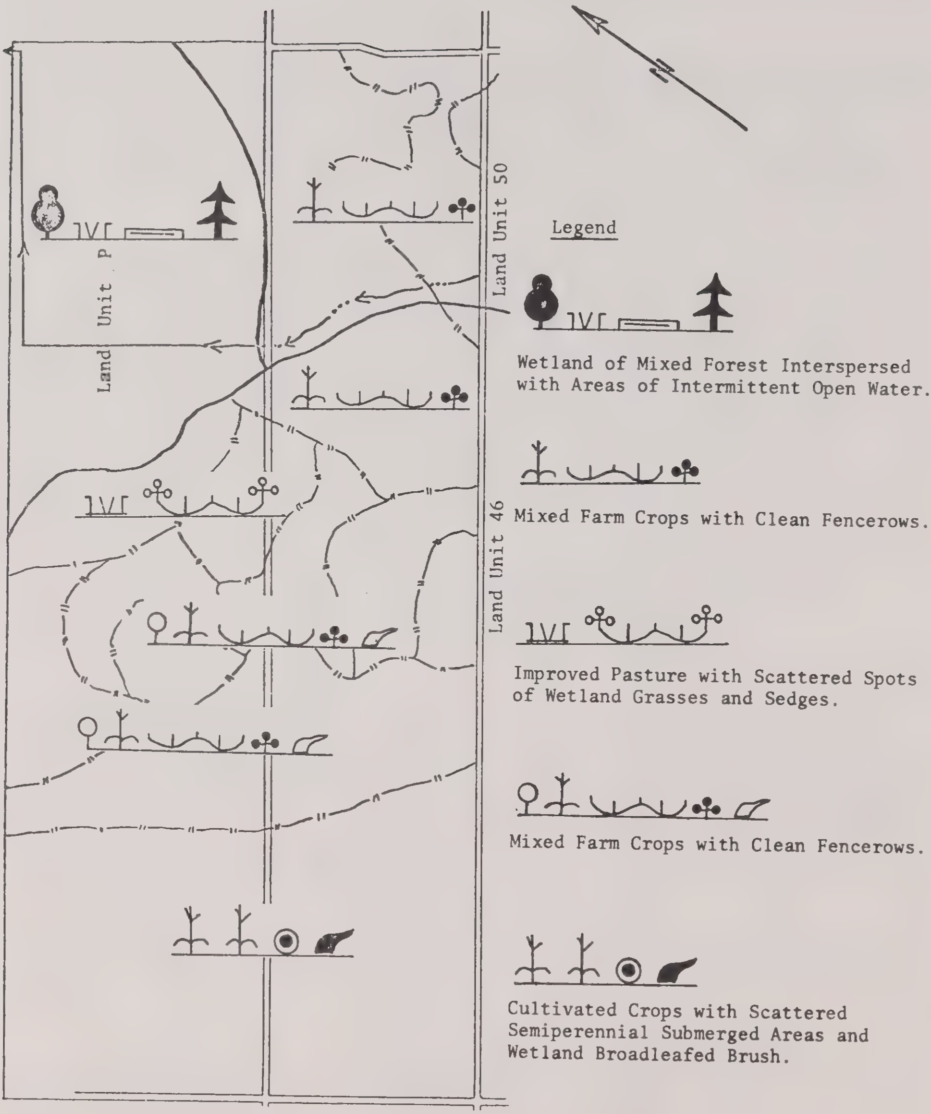
Physiographic Site Associations

Part Land Units 46, 50 and P

Scale: 1 in. = 20 ch.



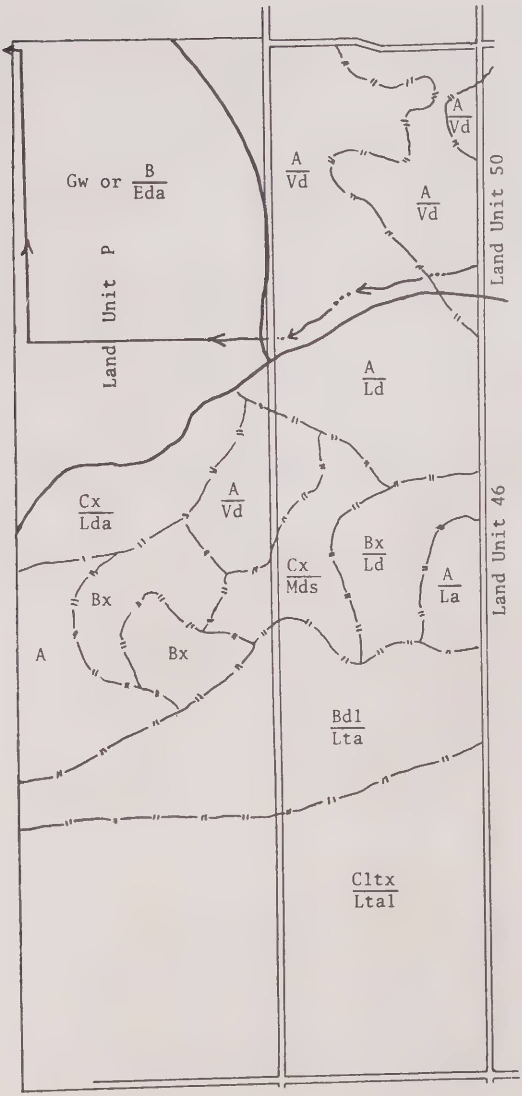
Map 5 Reference Area No. 1
Present Cover Types



Map 6 Reference Area No. 1

Evaluation for Agricultural Production

(computed at supra-farm levels)



Capability Classes
(in numerator)

A highest in region
to
G lowest in region

Limitations

x variable moisture conditions (within profile or areawise)
d massiveness - not amenable to subsoiling
l high lime
w drainage beyond normal development
t steep slopes

Effort Classes
(in denominator)

Effort required to bring production up to potential indicated in capability rating.

Degrees of effort

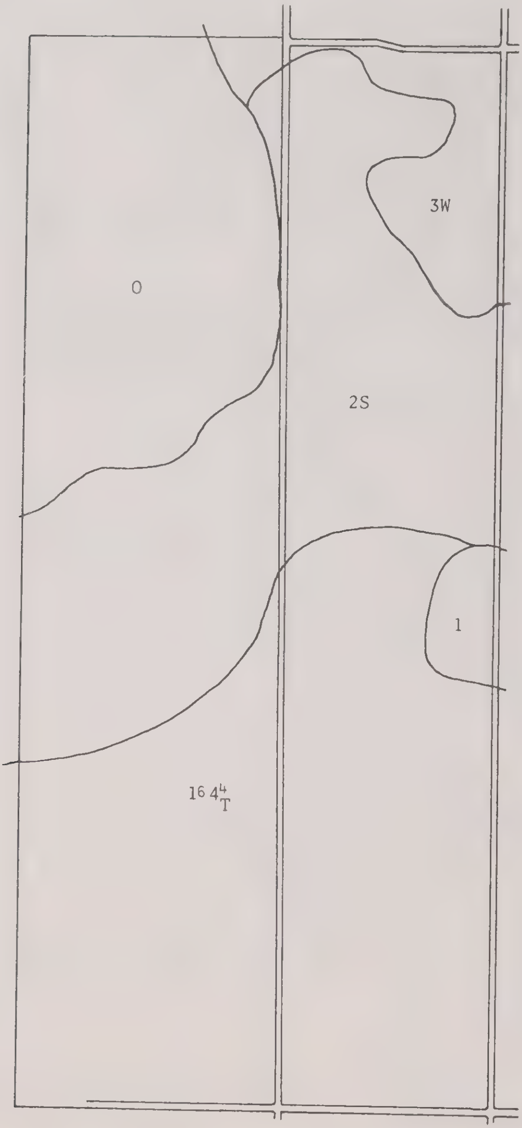
V very low
L low
M moderate
H high
E extremely high

Kinds of effort

a applying fertilizer lime, green manure or other amendment
d draining
l levelling
s stoning
t tilling particularly subsoiling

Map 7 Reference Area No. 1

Agricultural-Use Capability Rating According to A.R.D.A. Map 31D



Legend

0 Organic Soils (not placed in capability classes)

3W Third Class having excess water

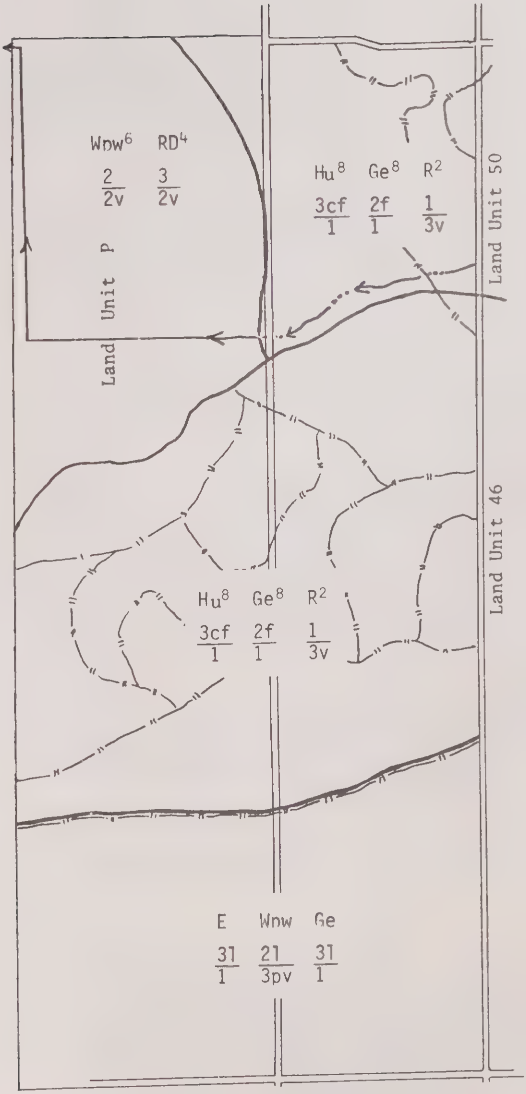
2S Second Class having adverse soil conditions

1 First Class no limitation

$1^{6}4^{4}_{T}$ 60 percent First Class 40 percent Fourth Class with adverse topography

Map 8 Reference Area No. 1

Evaluation for Wildlife Production



Species

Wpw - Puddle and wood ducks and other waterfowl

R - Ruffed Grouse

D - Deer

Hu - Hungarian partridge

Ge - Migrant geese (pasture)

E - European hare

Wpw^6 RD^4 - 60% of area rated for waterfowl and 40% for deer and grouse.

Fractionated Rating

Numerator

Classes 1 (highest) to 7 (lowest)

Kind of Limitation:

- c climate
- f soil fertility (on sandy areas)
- l high lime
- m moisture deficiency

Denominator

Degree of Effort:

1 (lowest) to 5 (highest)

Kind of Effort:

- v conversion of cover type
- p ponding
- f fertilizing

6.513 Agricultural Production. Map 6 indicates the range in agricultural capability derived from an interpretation of the sites examined in the field in terms of the levels computed at the supra-farm level.

The range in the entire reference area is from A to G due to the inclusion of three land units within the reference area. A portion of the reference area lies in Land Unit 50. Approximately one-half of the whole of this land unit is Class A including that falling within the reference area. Since there were other areas of lower potential, the rating for the whole of Land Unit 50 was reduced to ABC (Class 2 as determined in Table 7).

The easterly portion of the reference area which was rated Class A by the study group is rated Class 3 on Map 31D (A.R.D.A. 1967) presumably because the Simcoe County Survey Report indicates it to be the poorly drained Atherley Clay. However, it now produces at a higher rate than Class 3 and the 1968 study group was of the opinion that this land could be brought into Class 1 production by the application of inputs normal for that class (Section 6.13).

The portion of the reference area which is part of Land Unit 46 (loams and sands) was rated CBA in about the proportion of 50, 30 and 20 percent. The resultant for this combination is Class 2. The study group rated the entire Land Unit 46 as BCA which is also Class 2.

Map 7 is presented for purposes of comparing the A.R.D.A. rating of land for agricultural use capability with that described above. The A.R.D.A. ratings are taken from areas shown on the map of a scale of 1:250,000. On this map the westerly portion of the reference area is rated $1^{6}4^{4}_{T}$, meaning that 60 percent of the area is Class 1 and 40 percent Class 4. Because of the general rating it is not known whether the westerly part of the reference area is Class 1 or Class 4. This is an area of Otonabee loam which has an A.R.D.A. rating of 4 wherever the topography is broken. However, in the opinion of the study group, the limitations (computed at the capability level rather than the suitability level) did not lower the rating below Class 3.

6.514 Wildlife Production. Map 8 indicates the capability of Reference Area 1 to produce wildlife. There are four main groups of wildlife considered, (a) farm wildlife on farmland, (b) ducks for the marsh area, (c) geese for both marsh and farmland, and (d) woodland wildlife for forested fringes around the marsh.

The area has a relatively high potential for the wildlife species rated and there is only a relatively small degree of effort required to obtain the potential level of production.

6.52 Reference Area 2

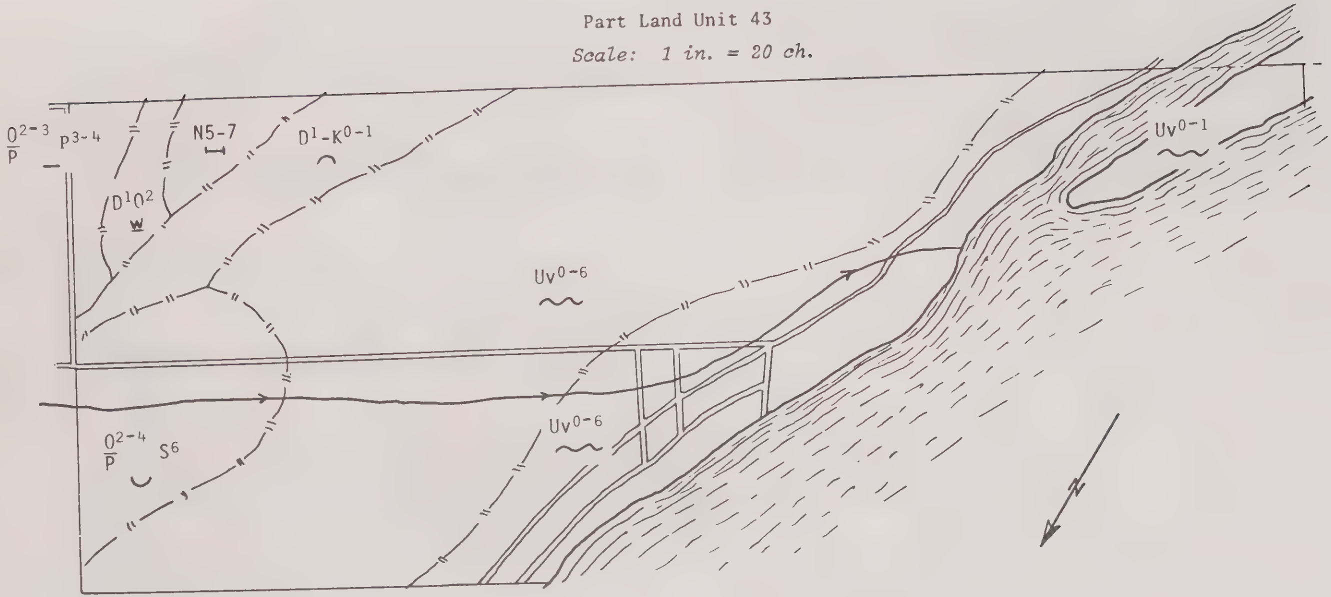
6.521 Physiography. This reference area, the physiography of which is shown on Map 9, is a representative portion of the Wasaga Sand Plain - Landform Pattern V on Map 2. Except for the extreme south-east corner it is a series of beaches formed during and since the down-draining of glacial Lake Nipissing. Locally the sand has been blown to form dunes. The area is a pattern of dry ridges and moist depressions. The soil materials are generally high in lime.

Map 9 Reference Area No. 2

Physiographic Site Associations

Part Land Unit 43

Scale: 1 in. = 20 ch.



Legend

- *Drainage Ditch*
- *Land Unit Boundary*
- *Site Association Boundary*
- *Road*
- *Concession Line*
- *Stream*
- *Intermittent Stream*

Site Association Symbol

$\frac{O^{2-3}}{P}$ P^{3-4} - Shallow mantle of Oro sand over Peterborough loam; moisture regime 2-3 with local areas of Peterborough loam MR 3 and 4.

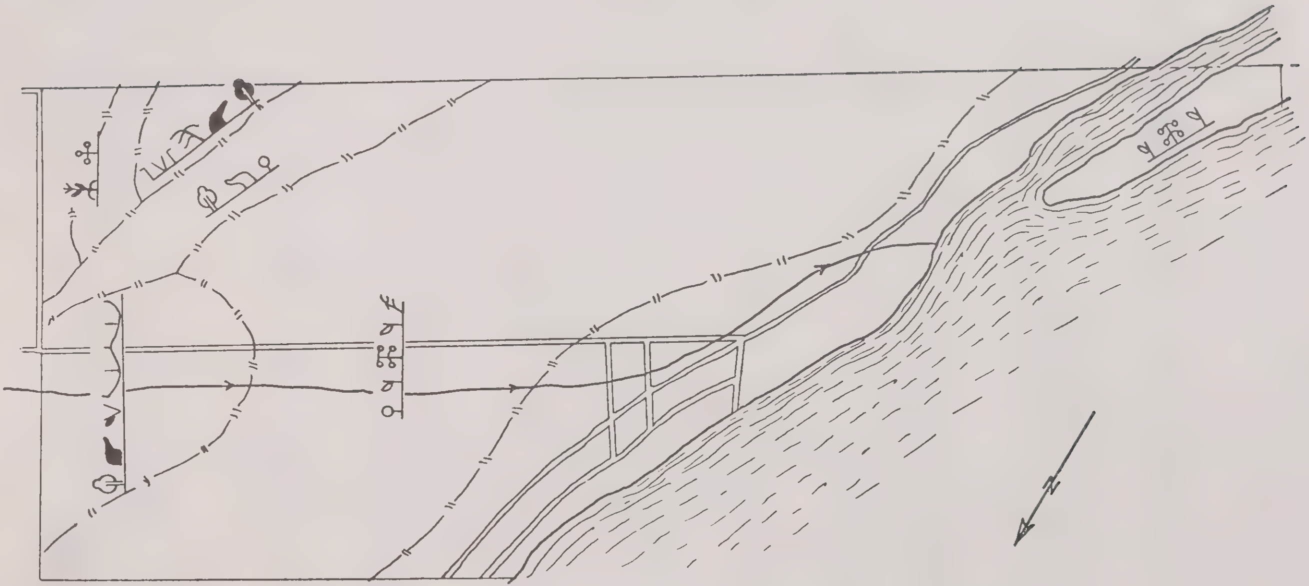
See Table 6
Landtype symbols, etc.

Relief

- low ridge
- slight depression
- gently undulating

Map 10 Reference Area No. 2

Present Cover Types



Grain Hoe Crop Cover, Leguminous Forage and Pasture Crops.

Wetland with Sedges, Shrubs and Stunted Trees, and Tall Wetland Broadleafed Tree Cover.

Dryland Broadleafed High Shrubs and Stunted Tree Cover, and Tall and Short Dryland Broadloeafed Tree Cover.

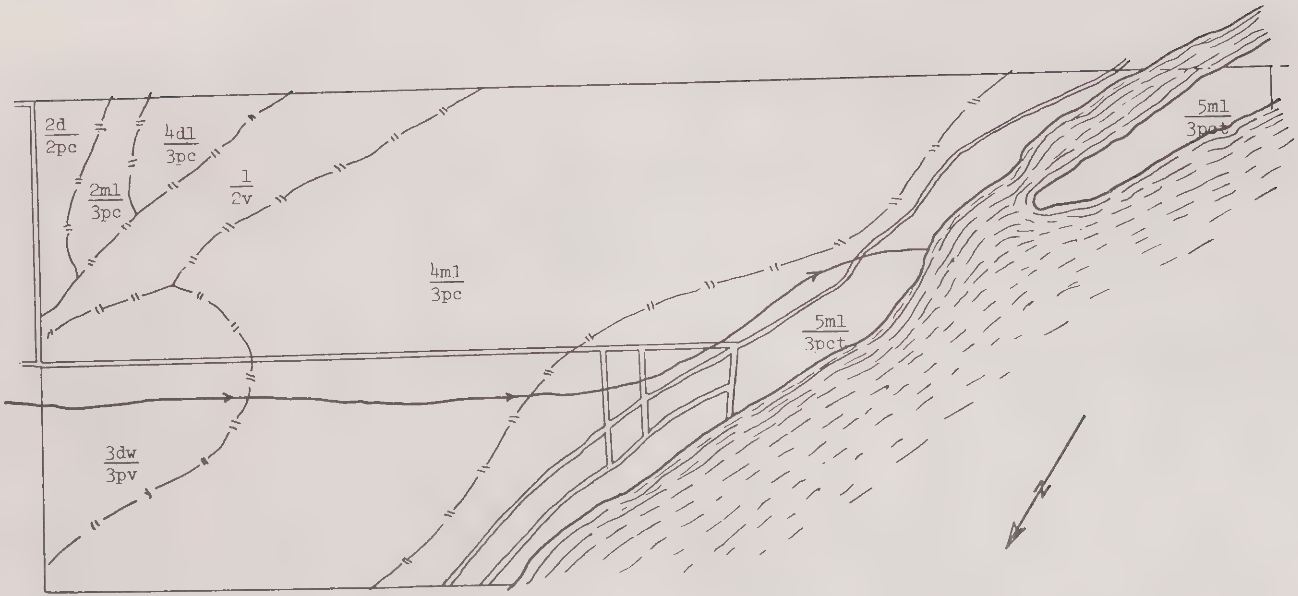
Tall Dryland Broadleafed Tree Cover, Wetland Broadleafed High Shrubs and Stunted Tree Cover, Wetland Sedge Cover, Dryland Grass Species.

Short Dryland Broadleafed Tree Cover and Sedge Cover, Non-Leguminous Forb Cover (Weeds), Scrub and Stunted Coniferous Cover.

Dryland Sedge Cover, Non-leguminous Forb Cover (Weeds)

Map 11 Reference Area No. 2

Evaluation for Timber Production



Map Symbol

Numerator - Capability Rating

Level of Limitation

Class 1 (Least Limitation - Highest Production) to Class 7 (Greatest Limitation - Least Production)

Kind of Limitation

d density of clay or compaction of till

m moisture deficiency

w moisture excess

e excessive lime (deficiency of nutrient due to fixation)

Denominator - Suitability Rating

Degree of Effort

1 Very low degree

2 Low degree of effort

3 Moderate degree of effort

4 High degree of effort

5 Extremely high degree of effort

Kind of Effort

v stand conversion (overcoming *vegetative* competition)

p planting and tending (conversion of field and scrubland to forest)

c site-conditioning humus-building - nurse crops

t time - often waiting period of one full rotation

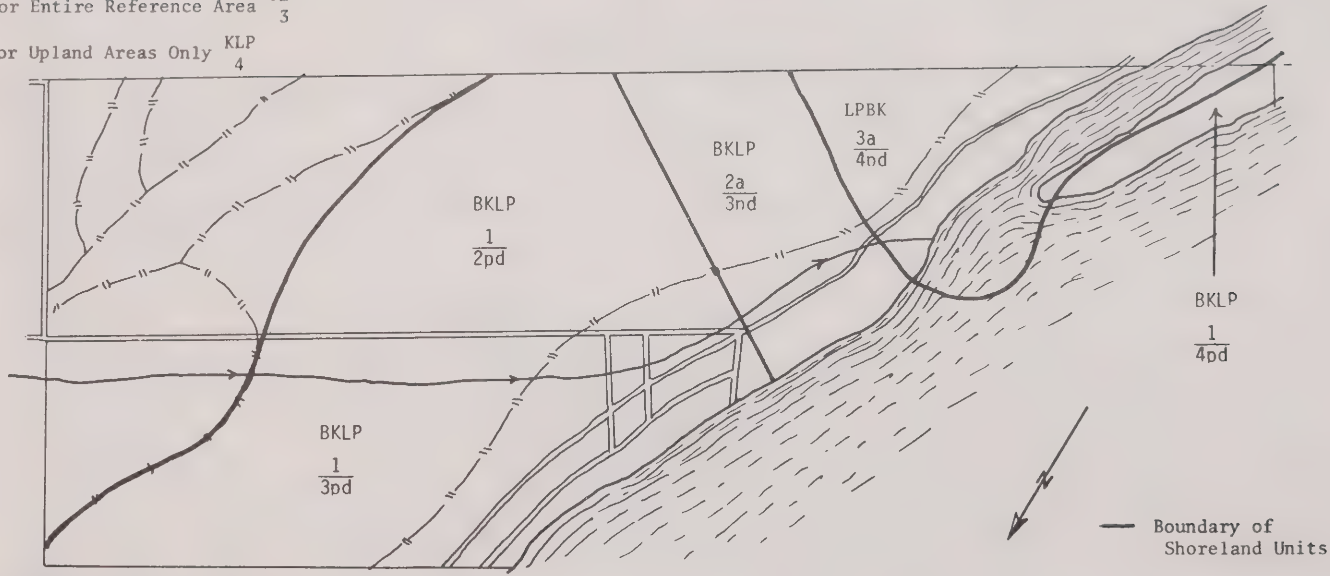
Map 12 Reference Area No. 2

Recreational Land Use Evaluation

Rating

For Entire Reference Area $\frac{TE}{3}$

For Upland Areas Only $\frac{KLP}{4}$



<u>Kind of Recreational Activity</u>

B Bathing	L Lodging (cottages)	T Travelling and Viewing
K Tent and Trailer Camping	P Intensive Use Parkland	E Natural Environment Experience

<u>The Fractionated Symbol</u> - Recreational Land Use Evaluation

<u>Numerator</u> - <u>Capability Rating</u>

<u>Level of Limitation:</u> Class 1 (Least Limitation - Highest Production) to Class 7 (Greatest Limitation - Least Production)

<u>Kind of Limitation:</u> a area of wet beach

<u>Denominator</u> - <u>Suitability Rating</u>

A. <u>Shoreland Units</u>

<u>Degree of Effort</u>:
1 Very low degree
2 Low degree of effort
3 Moderate degree of effort
4 High degree of effort
5 Extremely high degree of effort

<u>Kind of Effort</u>:
p Pollution - fine organic particles
d Considerable distance from parking area

B. <u>Upland Units</u>

Not designated.

6.522 Present Cover Types and Present Use. The present cover types are shown on Map 10.

Farmland occupies a small portion in the south-east corner. There are three areas of woodland, two of which are wetlands with open areas of sedge and brush. The larger remaining portions are the beach ridges and depressions sparsely covered with scrub and sedge with a scattering of poplar and birches.

6.523 Timber Production. The capability of the area to produce timber is indicated in the numerator of the symbols on Map 11. The denominator of the symbol indicates the degree of effort required to bring the area up to its potential level of production.

6.524 Outdoor Recreation Rating. Map 12 presents the recreation land-use evaluation of the area. The potential of each landtype component is indicated in the numerator of the map symbols. The denominator indicates the degree of effort required to change the land from its present condition to that which will produce the potential indicated by its capability rating.

This part of the Wasaga Beach area should be Class 2 under the A.R.D.A. system of capability classification assuming that the present organic pollution is a recognized limitation.

The ratings for the upland units are not shown on the map. These areas have a high capability for many of the extensive types of open space recreation which are needed to complement the intensive activities along the beaches; such activities include hiking, viewing and cottaging.

6.53 Reference Area 3

6.531 Physiography. This reference area, the physiography of which is shown on Map 13, is representative of the Bass Lake Moraine portion of Landform Pattern III on Map 2. Although segregated by Deane (1950) from the rest of the flat topped moraine, this area differs only in the percentage of particles finer than medium sand found in the surface strata. For example, the area mapped as $\frac{E^2}{0}0^1$ on Map 13 (see Table 5 for a description of symbols) is typical of many areas in the 'till' portion of Landform Pattern III. Local patches, widely distributed throughout area $0^1\frac{E^1}{0}0$ have a compacted surface layer, indicating the possibility that these materials are part of the till cap even though they lack the higher percentage of fine sand and silt commonly found in till in areas further north. Although the lack of fine particles reduces the moisture-holding and nutrient-providing qualities of the soil, the compacted sand has a higher moisture retention capacity than loose sand. This is indicated by moisture regime 1, in 0^1, in contrast to the modal 0^0 of materials of this texture.

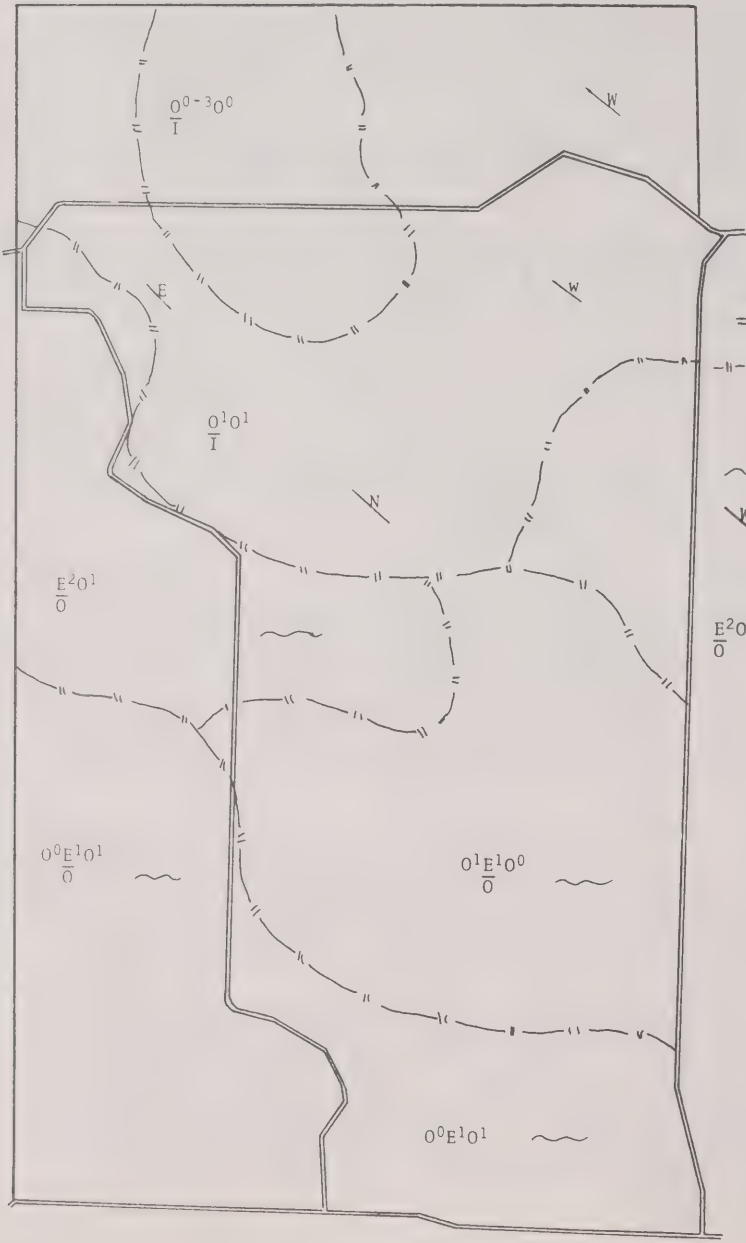
6.532 Present Cover Type and Present Use. The present cover type is shown on Map 14. The symbols indicate that on the smooth till-cap areas there are still fields in which a rotation of agricultural crops is grown but the number of fields under crop is being reduced gradually. The trend, however, is not toward increased acreages in timber production but to open-space types of recreation. This trend is demonstrated in this area as ski-resort developers are buying plantation land for lodging and ski runs. In addition, much of the land is being developed as Christmas tree plantations and for rural residences.

Map 13 Reference Area No. 3

Physiographic Site Associations

Land Unit 84

Scale: 1 in. = 20 ch. (approx.)



N

Legend

Road

Site Association Boundary

Relief:

Gently undulating

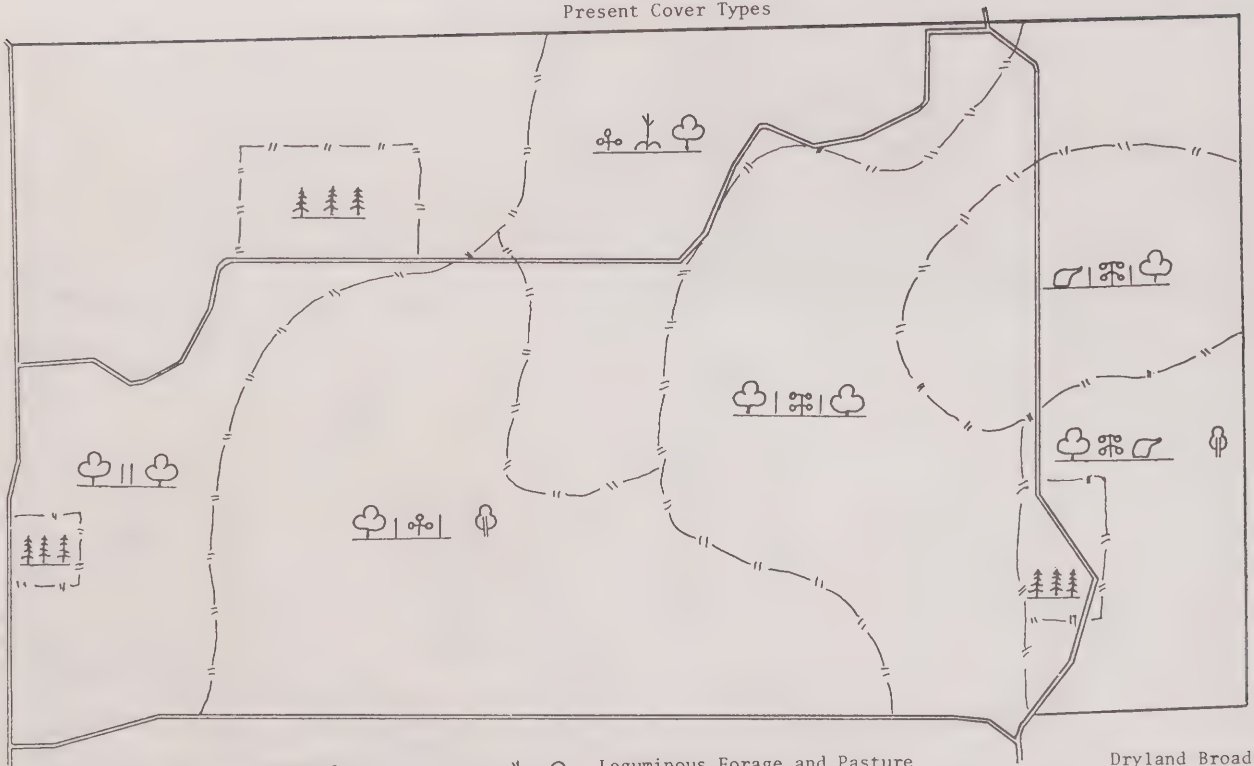
West slope

Site Association Symbol:

$\frac{E^{2}O^{1}}{O}$ Shallow mantle of fine and silty sand over Oro coarser sand; moisture regime 2 with local areas of Oro sand MR 1. See Table 5 for Landtype symbols, etc.

Map 14 Reference Area No. 3

Present Cover Types



Tall Dryland Conifer.

Open-Grown Dryland Broadleafed Tree Cover with Linear-leafed Herbs.

Open-Grown Dryland Broadleafed Tree Cover, Linear-leafed Herbs and Leguminous Forage and Pasture Crops.

Leguminous Forage and Pasture Crops, Cultivated Field Crops in General, and Open-Grown Dryland Broadleafed Tree Cover.

Open-Grown Dryland Broadleafed Tree Cover, Linear-leafed Herbs and Leguminous Forage and Pasture Crops.

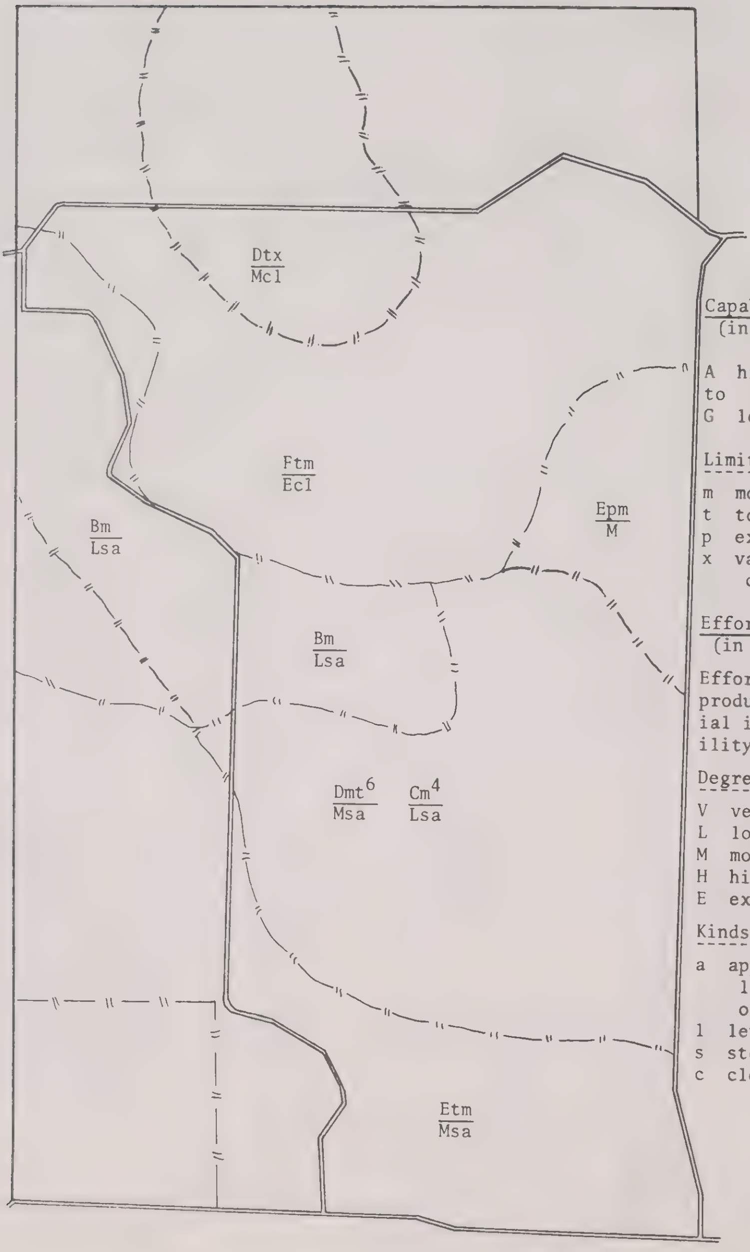
Dryland Broadleafed High Shrubs and Stunted Tree Cover, Linear-leafed Herbs and Leguminous Forage and Pasture Crops.

Open-Grown Dryland Broadleafed Tree Cover, Leguminous Forage and Pasture Crops, Dryland Broadleafed High Shrubs and Stunted Tree Cover, and Tall Dryland Broadleafed Tree Cover.

Map 15 Reference Area No. 3

Evaluation for Agricultural Production

(computed at supra-farm levels)



Capability Classes
(in numerator)

A highest in region
to
G lowest in region

Limitations

m moisture deficiency
t topography
p extreme stoniness
x variable moisture conditions

Effort Classes
(in denominator)

Effort required to bring production up to potential indicated in capability rating.

Degrees of Effort

V very low
L low
M moderate
H high
E extremely high

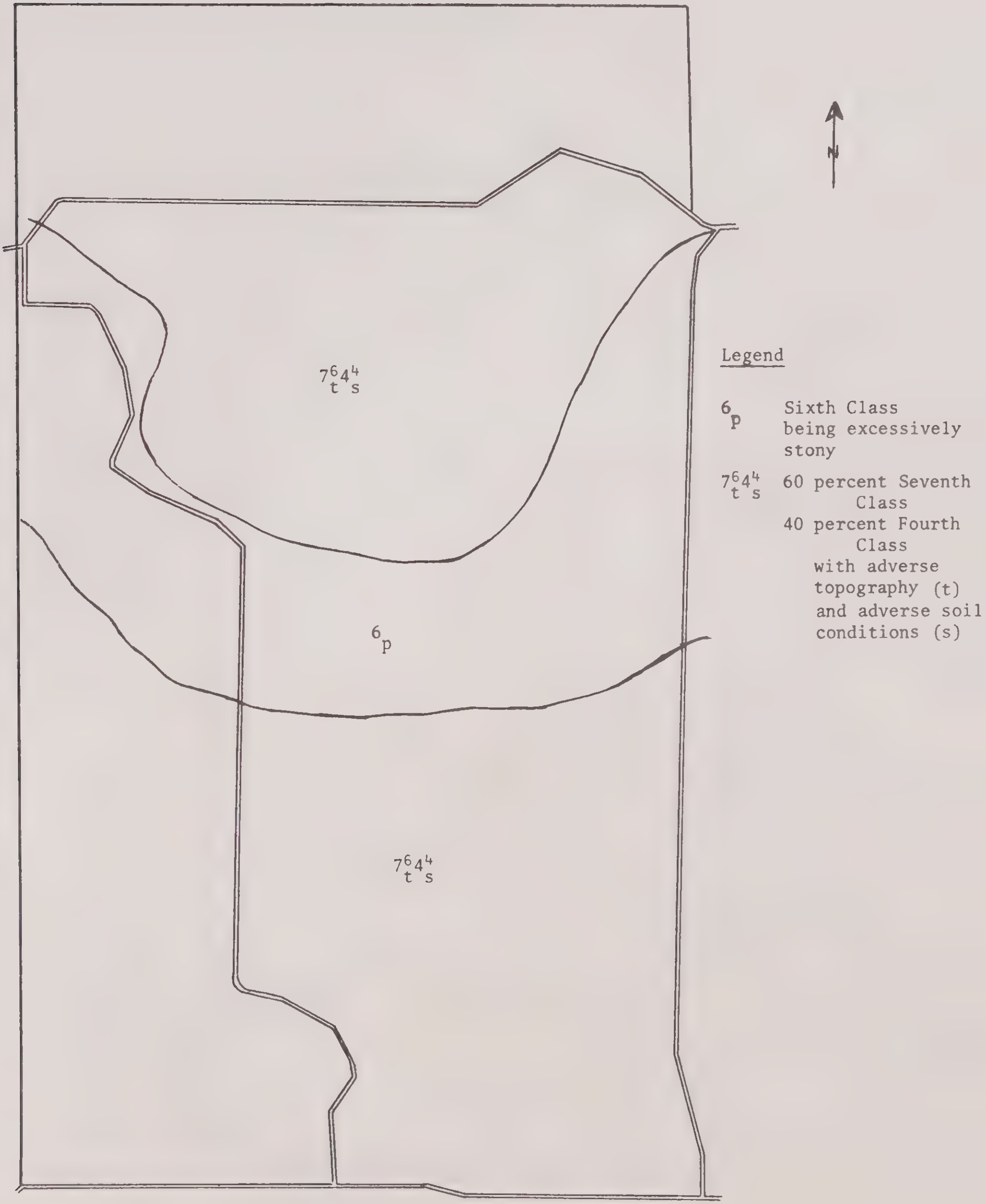
Kinds of Effort

a applying fertilizer lime, green manure or other amendment
l levelling
s stoning
c clearing

Map 16 Reference Area No. 3

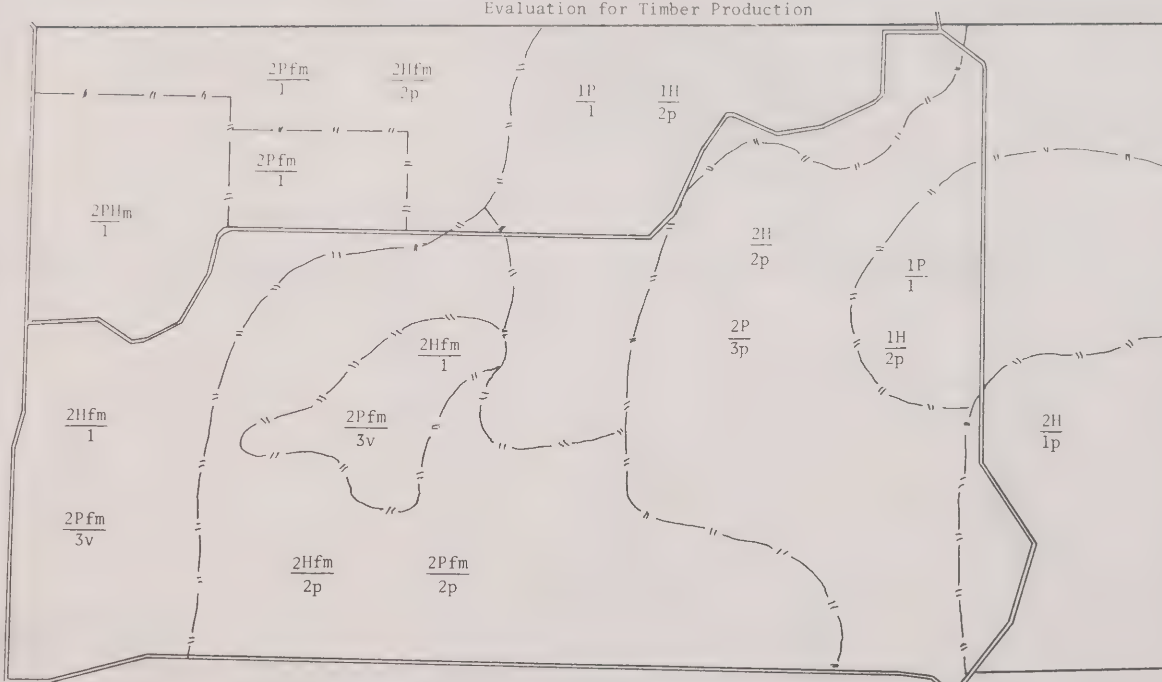
Agricultural-Use Capability Rating According to A.R.D.A. Map 31D

Land Unit 84



Map 17 Reference Area No. 3

Evaluation for Timber Production



Map Symbol

<u>Numerator</u> - <u>Capability Rating</u> [the capital letter indicates the land type read from Table 4)

<u>Level of Limitation</u>

Class 1 (Least Limitation - Highest Production) to Class 7 (Greatest Limitation - Least Production)

<u>Kind of Limitation</u>

f nutrient deficiency

m moisture deficiency

<u>Denominator</u> - <u>Suitability Rating</u>

<u>Degree of Effort</u>

1 Very low degree
2 Low degree of effort
3 Moderate degree of effort
4 High degree of effort
5 Extremely high degree of effort

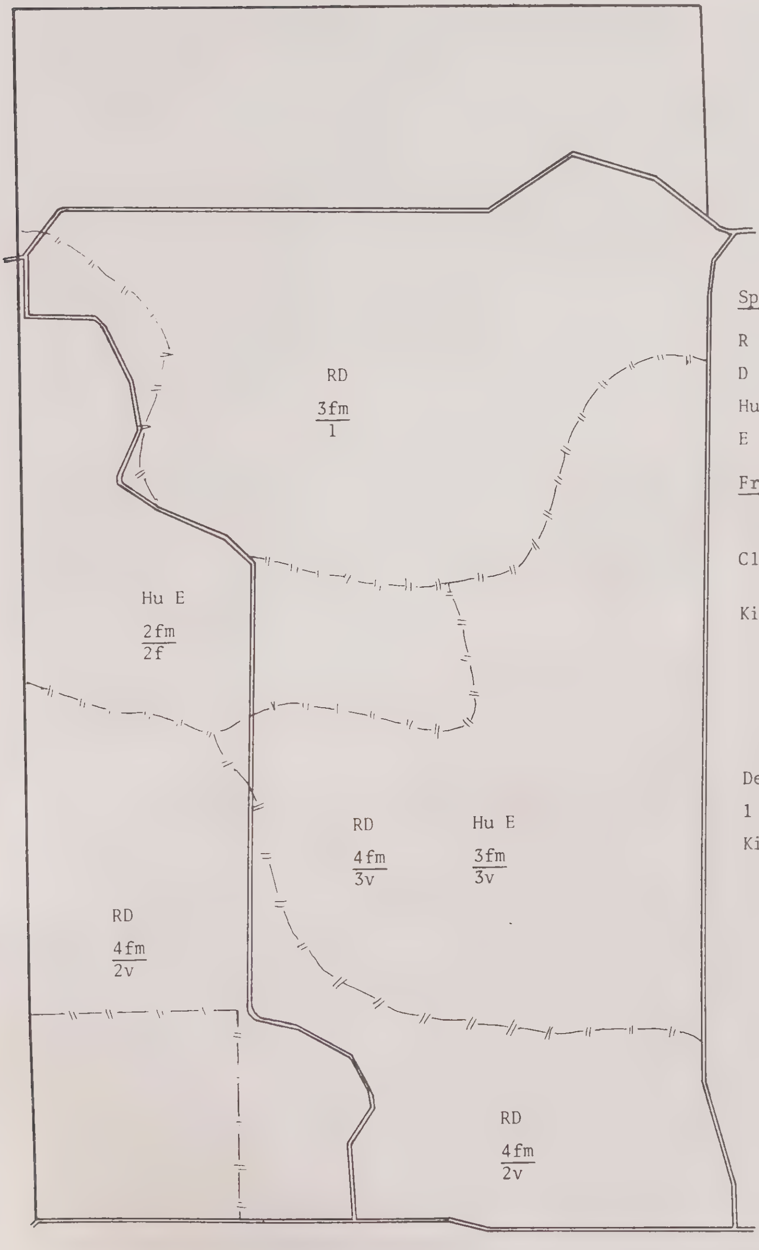
<u>Kind of Effort</u>

v stand conversion (overcoming *vegetative* competition)

p planting and tending (conversion of field and scrubland to forest)

Map 18 Reference Area No. 3

Evaluation for Wildlife Production



Species

R - Ruffed Grouse

D - Deer

Hu - Hungarian partridge

E - European hare

Fractionated Rating

Numerator

Classes 1 (highest) to 7 (lowest)

Kind of Limitation:

f soil fertility (on sandy areas)

m moisture deficiency

Denominator

Degree of Effort:

1 (lowest) to 5 (highest)

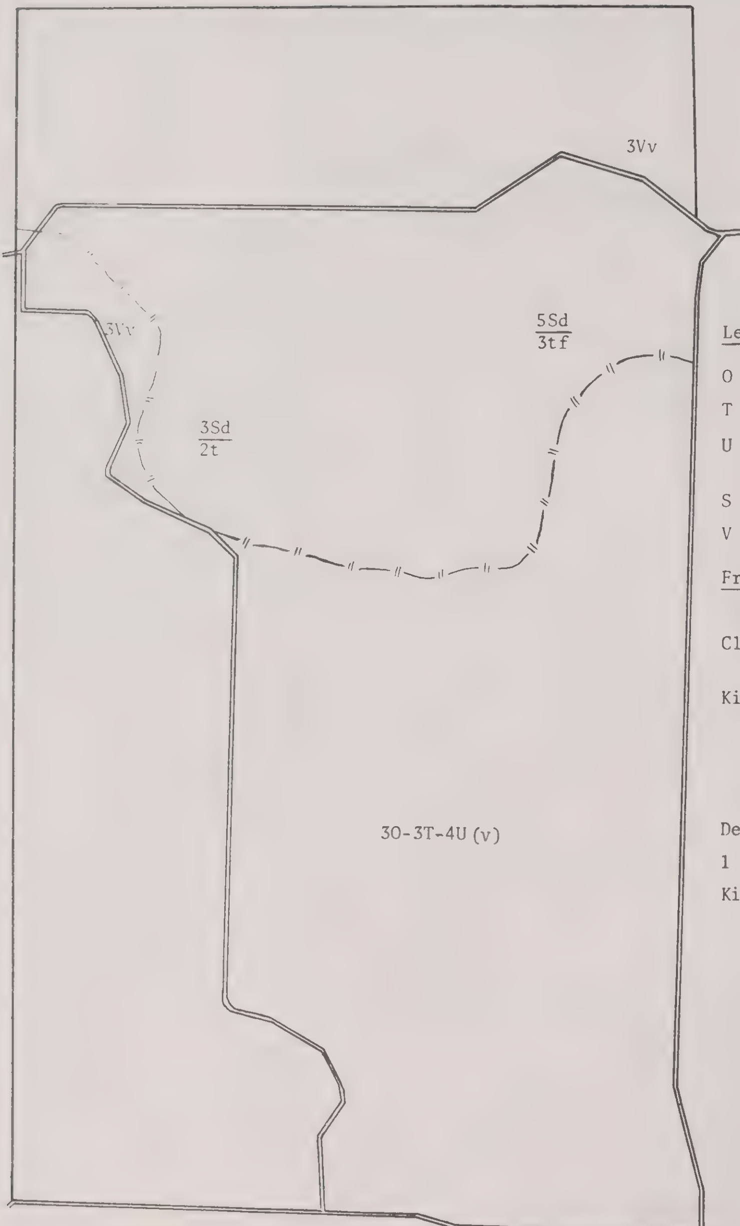
Kind of Effort:

v conversion of cover type

f fertilizing

Map 19 Reference Area No. 3

Recreational Land Use Evaluation



Legend

O Open space

T Travel

U Upland wildlife for hunting or viewing

S Skiing

V Viewing

Fractionated Rating

Numerator

Classes 1 (highest) to 7 (lowest)

Kind of Limitation:

d vertical drop

v variety

Denominator

Degree of Effort:

1 (lowest) to 5 (highest)

Kind of Effort:

t modification of topography

f modification of forest cover

6.533 Agricultural Production. The agricultural use evaluation is shown on Map 15. The limitations are computed at supra-farm levels, although these differ little from those computed at farm levels for this type of land. The two operations which the community might undertake to increase production on these areas are irrigation and levelling. Irrigation for this upland area is considered not feasible at the community level. Levelling might be a legitimate community program if food were in great demand. Otherwise the relief is an asset not a limitation for the multiple-use type of land management as either forest or open-space recreation. In either type of multiple use, sizeable areas of farm or pasture crops are required to provide non-wooded open space for aesthetics and physical recreational activities. For example, under good recreational land management where aesthetics were recognized, the valley flat at the north centre classified as $\frac{Dtx}{Mcl}$ would be in farm crops to provide a view from the lodges and other observation points around the valley. Although an agricultural economic analysis may indicate that it would not pay to invest a moderate input to secure a D level of output (as indicated by the symbol), the additional benefits which would be provided to the recreationists might be sufficient to warrant this use development as a community effort.

On the upper flats, the distribution pattern of Class B and C lands is such that viable farm units are difficult if not impossible to attain through farm consolidation. Here, too, under a multiple-use type of recreational land management these areas of higher agricultural potential could be used to provide not only food but also other amenities requiring open space. In some locations strategic observation points and vistas could usefully be provided regardless of the agricultural capability of the land. Generally, however, land of better agricultural potential which provides a better opportunity for such development can be found elsewhere.

The classification on Map 16 has been taken from ARDA Map 31D (1967). The area mapped $7\frac{6}{T}\ 4\frac{4}{S}$ is part of a much larger area which is the Bass Lake Moraine. It may be assumed that within the broad areas there are a few specific areas of sufficient size to provide viable farm units. However, the overall rating for the area suggests that it is not well suited to agricultural production.

6.534 Timber Production. The capability of the land for timber production is shown in the numerator of the symbols on Map 17. The denominator of the symbol indicates the degree and kind of effort required to bring the present production up to the potential of the area.

The method by which patterns of capability ratings are resolved into a single rating, i.e., 1 to 7, or a standard three-level rating, e.g., ADG, is discussed in Section 6.502. The need for a similar treatment of 'degree of effort' is apparent. However, the extreme variation in present cover and in site conditions within much shorter distances than the changes which occur in physiography suggests that degree of effort or other suitability ratings will be extremely general on maps of scales smaller than 20 chains to the inch. Map 17 provides an example of a scale of mapping having practical value at both the local and landscape unit level.

6.535 Wildlife Production. Areas of sufficient size to support both farmland and woodland types of wildlife may be found within areas the size of the reference area. In fact, if the area were placed under multiple-use land management, both farmland and woodland should be managed to improve the vegetative cover for both types of wildlife. Evaluation for wildlife production is shown on Map 18.

6.536 Outdoor Recreation Rating. The denominator of symbols on Map 19 indicates the type and rating of those recreational activities which have developed in this area or for which there is potential for development.

In general, the recreational activities will be intensive in the ski hill area. However, cross-country skiing, hiking and snowmobiling could develop in the remaining areas to an intensive level.

No degree of effort has been indicated for the extensive types of recreation on the upland areas. Here degree of effort cannot be indicated until the type of management has been selected and a management plan made.

6.54 Reference Area 4

This reference area is the second one selected to represent the North Nottawasaga Till-capped Clay Plain, the other being Reference Area 1. Two areas were selected for study in order to compare areas of high and of low agricultural capability. Also Reference Area 4 is presented in this report to demonstrate differences in methodology in classifying the capability of land for agricultural production (Section 6.542).

6.541 Physiography. The site associations mapped by the field party are shown on Map 20. It is interesting to note that the Tioga Sand area on the soil map (Hoffman et al 1962) ranges in petrography from non-limy Flinton (F) to high lime Uxbridge (U) with no areas of the modal Tara (T) large enough to map (Table 6).

6.542 Agricultural Production. Owing to limitations of time in the field, the 1969 team who studied this area confined its efforts to the application of the Canada Land Inventory classification to the homogenous units they examined and mapped in the field. Their interpretation of the agricultural use capability of the features examined in detail is shown on Map 21. The classes and symbols used are those of A.R.D.A. (1967a).

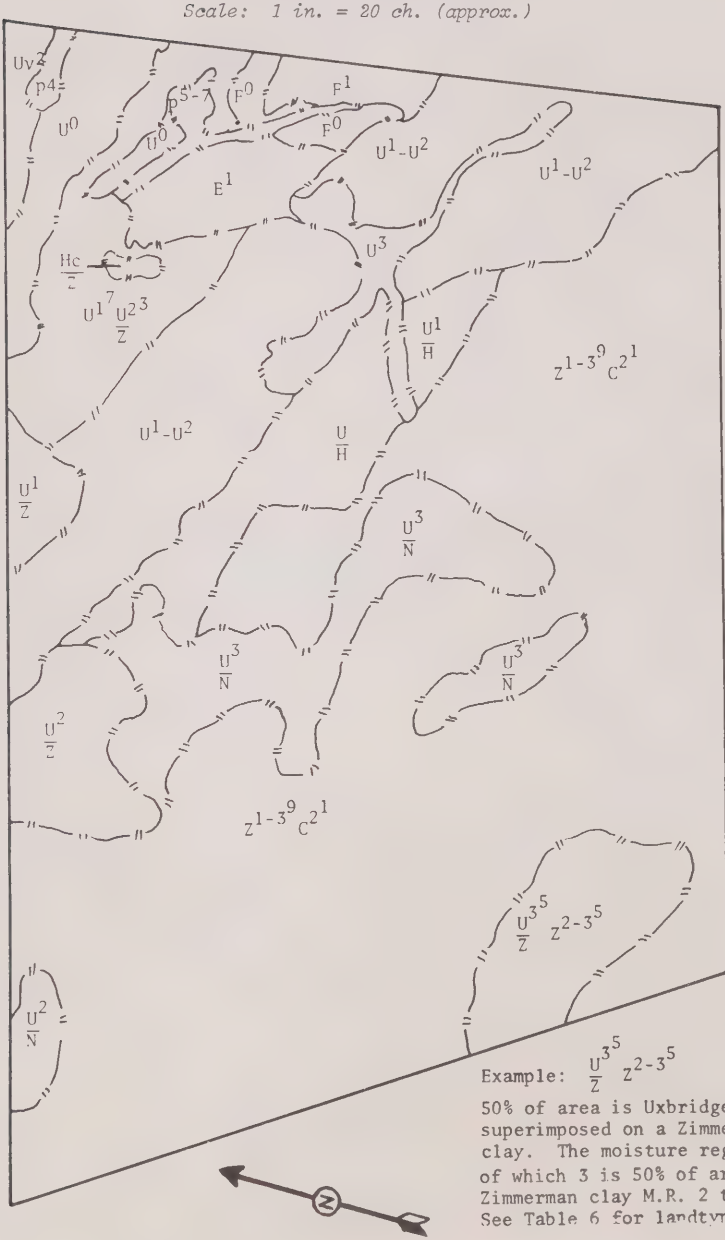
Map 22 indicates the rating presented on ARDA Maps 41A and 31D (1967a,b). These ratings are derived by the Canada Land Inventory (C.L.I.) classifiers from the Ontario Soil Survey Report (Hoffman et al 1962). The Class 1 area is that which was mapped as Smithfield silty clay, Edenvale and Wiarton loam, the Class 2S as Smithfield silty clay with scattered blocks of Berrien, and the 4S area as Tioga sand on the soil map. This C.L.I. rating (4S) is an average rating applied to all areas of Tioga sand which ranges widely in capability as shown on Map 21.

This study illustrates one of the main weakness of the C.L.I. system, namely that of using a single designation rather than recognizing a pattern for areas mapped as homogeneous in the Soil Survey maps (scale: 40 chains per inch). The 2S area (Map 22) is not an area of Capability Class 2 throughout but an average of Class 1 (Smithfield silty clay loam) and Class 3S (Berrien sand). The fact that 2S describes a few local areas is beside the point for it is doubtful if this was known to the compiler who was performing a mechanical 'averaging'. The variation in land capability within local areas necessitates the recognition of patterns of land capability at all scales, although the components of the pattern can be mapped only at the largest scale.

Map 20. Reference Area No. 4

Physiographic Site Association

Scale: 1 in. = 20 ch. (approx.)

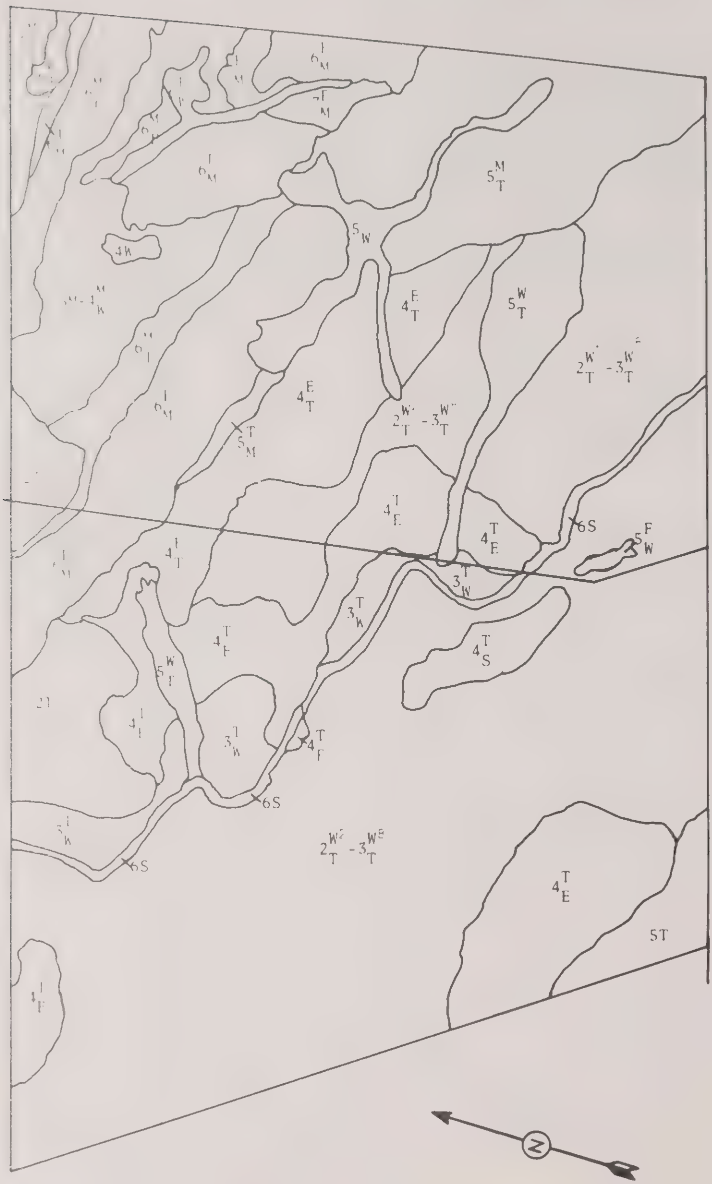


Example: $\frac{U^{3^5}}{Z}$ Z^{2-3^5}

50% of area is Uxbridge sand superimposed on a Zimmerman clay. The moisture regime (M.R.), of which 3 is 50% of area, is Zimmerman clay M.R. 2 to 3. See Table 6 for landtype symbols.

Map 21 Reference Area No. 4

Agricultural-Use Capability (Detailed Rating)



Legend

Rating:

1 (highest) to 7 (lowest)

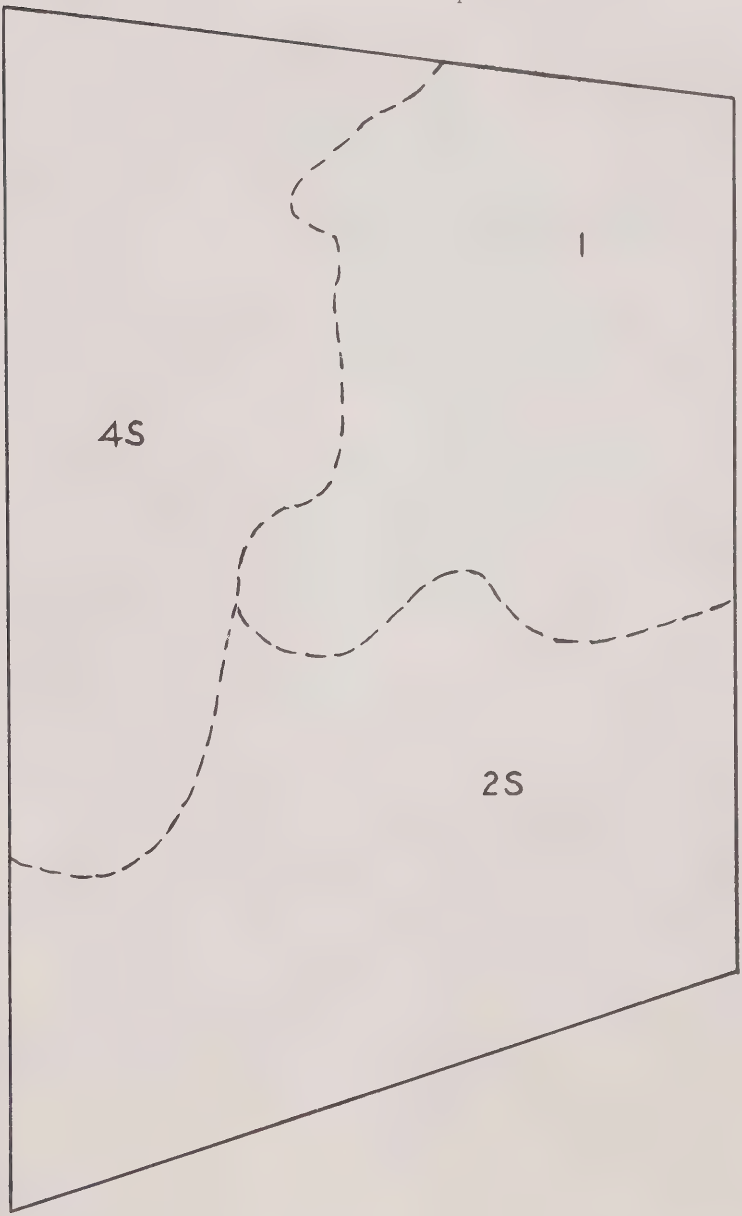
Limitations (Subclasses):

- W excess water
- E erosion damage
- T adverse topography
- M moisture limitations
- F low fertility
- S adverse soil characteristics

Proportions in different classes in a given unit are indicated as indices, e.g., $2\frac{W^2}{T}-3\frac{W^8}{T}$ indicates

20% class 2
80% class 3

Map 22 Reference Area No. 4.
Agricultural-Use Capability Rating
A.R.D.A. Maps 31D and 41A



Legend

Rating:

1 (highest) to
7 (lowest)

Limitation (Subclass):

S adverse soil
characteristics

Chapter 7

SCENARIOS FOR MULTIPLE USE IN THE STUDY AREA

7.0 GUIDELINES FOR THE DEVELOPMENT OF SCENARIOS

7.01 Introduction

The concept of a 'scenario' as a planning tool has been discussed in detail in Section 2.63. Scenarios are defined as "hypotentical sequences of events constructed for the purpose of focusing attention on causal processes and decision points" (Kahn and Wiener 1967). Clearly, scenarios can differ according to the objectives set forth and to the ways in which the objectives are accomplished.

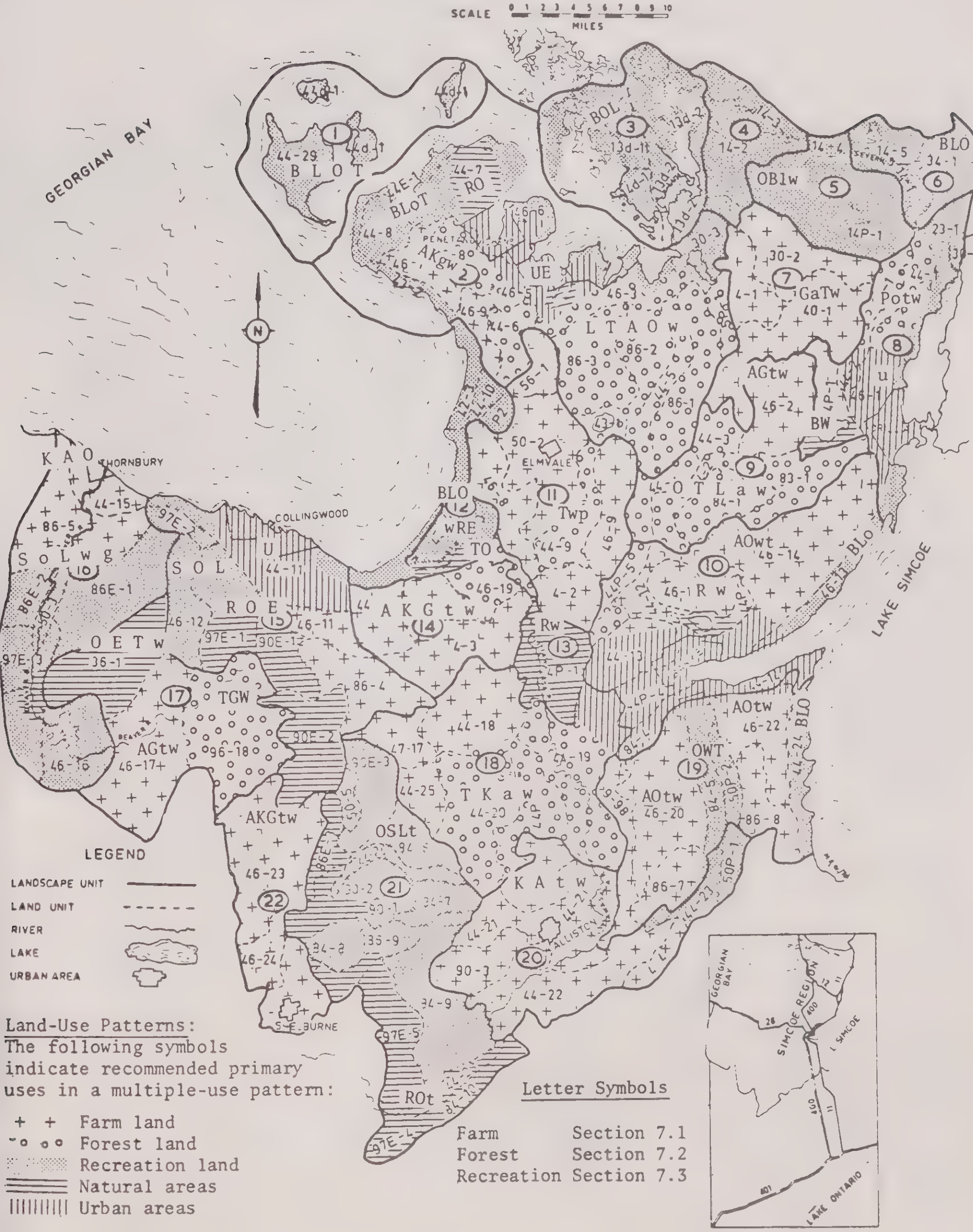
A land-use plan is the concrete expression in map and text form of a goal which is considered desirable by a governing body which has the power to approve and implement it. Superficially it might appear that there could be little affinity between the imaginative, impressionistic picture of the 'unknowable' future presented by a scenario and the practical and feasible scheme of development presented by a land-use plan. However, if the goals of a land-use plan have not originated within the matrix of a scenario, the plan is not an instrument of development bur rather a strait-jacket which is just as impractical as the scenario and much more damaging. Such plans are responsible for establishing institutions not compatible with human well-being.

To perform this role, the scenario must indicate not only the types of production recommended but also the place and timing of production.

Two examples of Scenario 2000 (one developed in 1968, Maps 23 and 23a, and the other in 1969, Maps 24 and 24a) are presented. Although much of the text has been selected from the 1968 student reports, an attempt has been made to present a consensus of the studies of both years. The students in each session of the Ecological Land Use Planning Course indicated on a map of the Simcoe Region the kind of land use which they, as citizens of that region, would consider to be the best harmonic development both intraregionally and interregionally within the Province of Ontario. In order to present such a generalized picture it was necessary to use patterns of land use, the components of which were grouped according to goals set in the context of management and regulation, not necessarily those operating at the present time. It was within this framework that the landscape features were observed, classified and evaluated for 'single' land uses. It was also within this context that homogenous areas with respect to primary production were grouped into land units of convenience for an evaluation of their role in total geographic production. This framework also dictated the placement of the various land uses into groups useful in land appraisal at the community level. The patterns of 'single' uses which make up these multiple land-use patterns are presented in Section 7.04 below.

SCENARIO 2000 - SIMCOE REGION

Map 23 Prepared by the 1968 Group



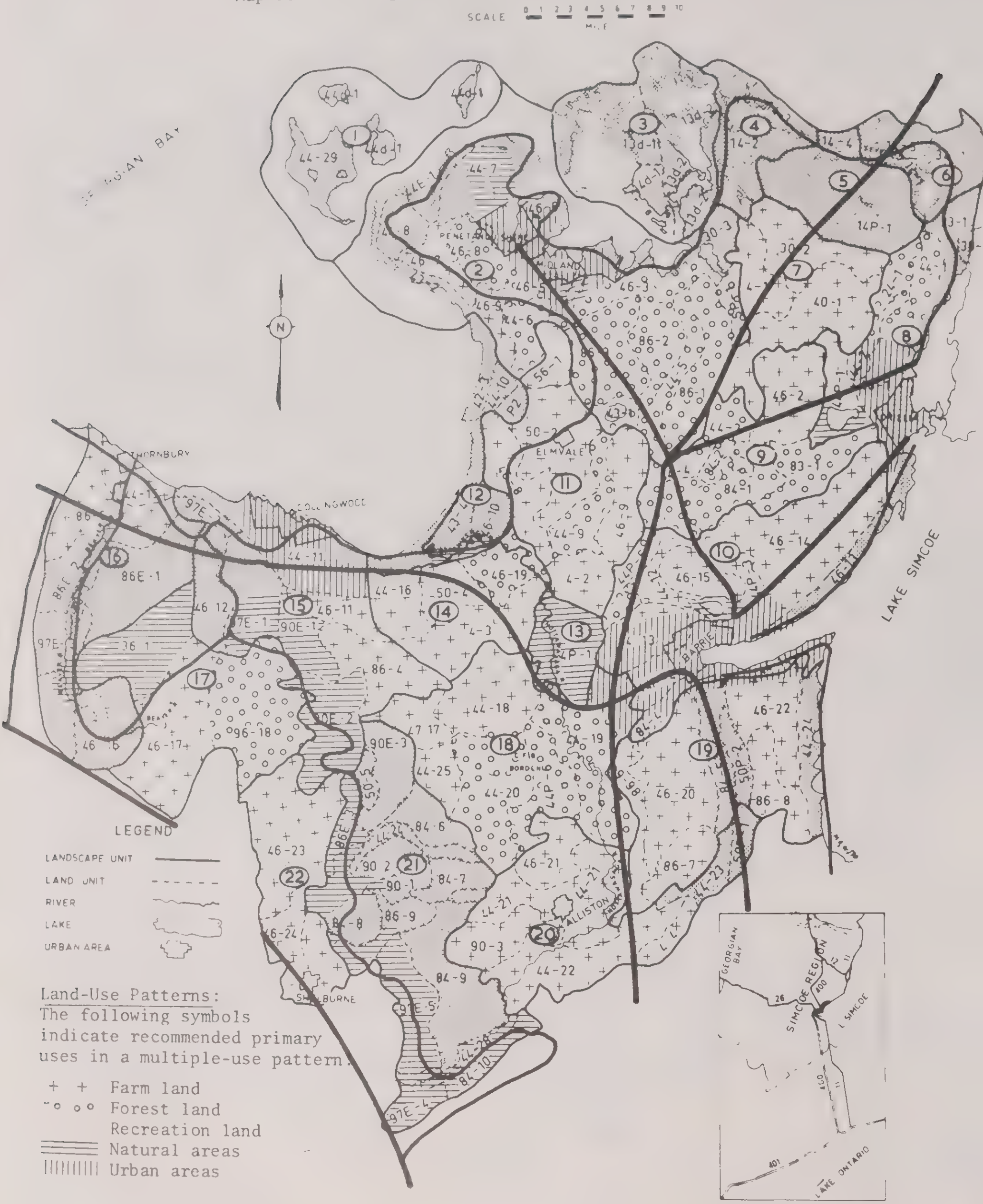
Land-Use Patterns:
The following symbols indicate recommended primary uses in a multiple-use pattern:

- \+ + Farm land
- o o o Forest land
- Recreation land
- Natural areas
- Urban areas

Letter Symbols

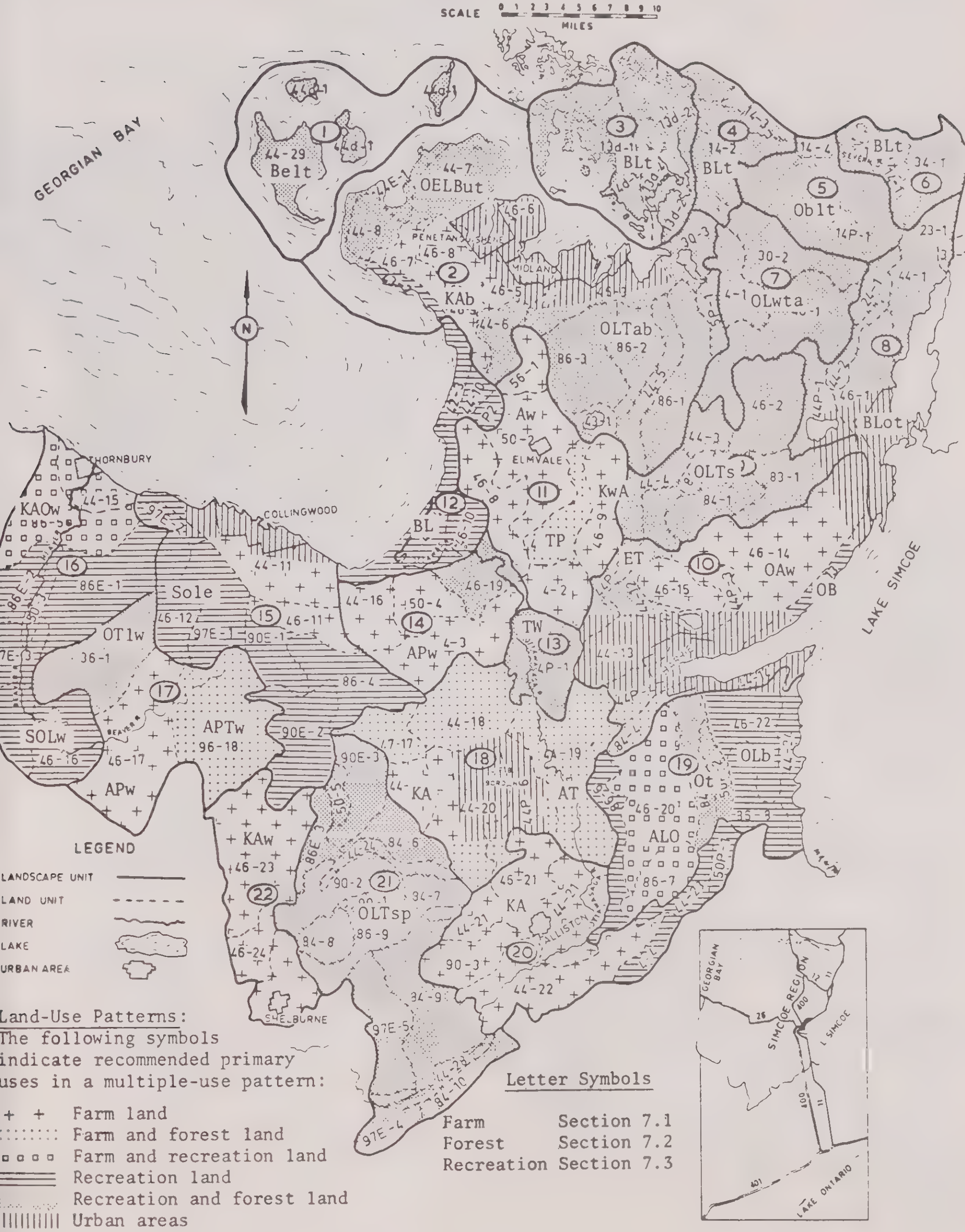
Farm	Section 7.1
Forest	Section 7.2
Recreation	Section 7.3

Map 23a Showing Primary Transportation Facilities

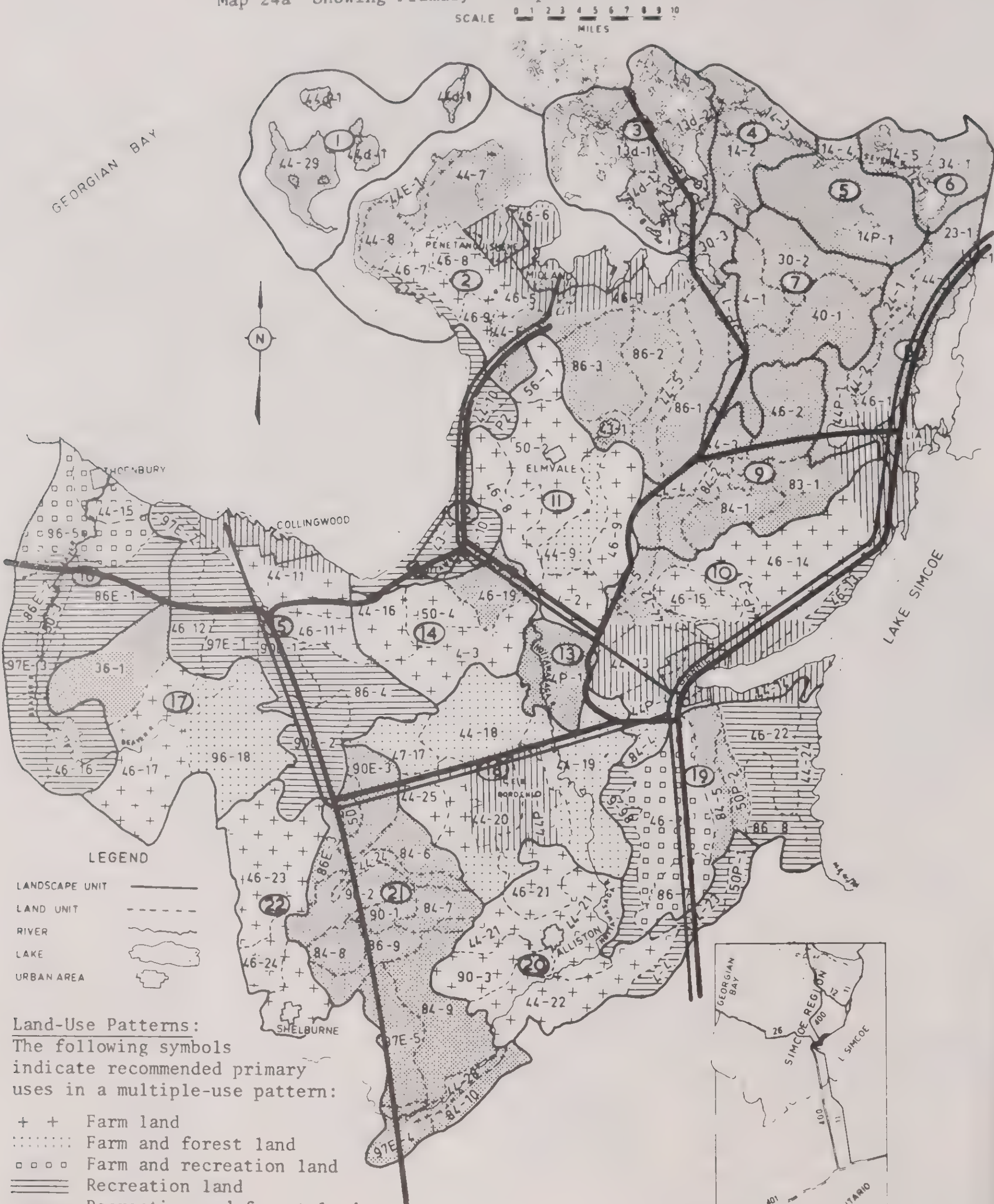


SCENARIO 2000 - SIMCOE REGION

Map 24 Prepared by the 1969 Group



Map 24a Showing Primary Transportation Facilities



Land-Use Patterns:
The following symbols indicate recommended primary uses in a multiple-use pattern:

+ + Farm land
::::::: Farm and forest land
□ □ □ □ Farm and recreation land
═══ Recreation land
····· Recreation and forest land
||||||||| Urban areas

7.02 Formulation of Goals

A goal is a consensus at the national or provincial level of that which is 'the good' for the constituency at this level of generalization. For example, an ecological framework for the design of the environment is discussed in the President's Council on Recreation and Natural Beauty (1968) as follows:

"A human environment is composed of various systems and sub-systems including a residential system, a park system and educational system, a commercial system, an industrial system, an agricultural system, a communications system and a transportation system. The goal of all these systems should be a total environment capable of satisfying the broadest range of human needs. The effects of activities within each of these systems must be evaluated for their influence on all other systems constituting the environment. A transportation system, for example, should be measured not merely for its efficiency in moving people and goods, but for its effect on parks, schools, the distribution of commercial and industrial facilities, the total development of the community and the individuals who compose it."

Goals that take these points into consideration have been presented in synoptic form by the Prime Minister of Ontario (1966) as follows:

Goal 1: the provision of the best possible environment for the people of Ontario, and at the same time,

Goal 2: the creation and maintenance of an atmosphere which would encourage economic growth and development throughout the province.

These were the goals that were accepted as general guidelines in the development of the scenarios during the summer course.

7.03 Formulation of Planning Objectives

As described in Section 2.52, objectives are a more specific statement than goals, and provide a set of guidelines for the proposed planning activities. The basic assumptions used by the students as their framework of reference were as follows:

(a) That the Simcoe study area would be designated as a 'region' (Section 3.46), and that a form of regional government would be established having the power to draft, approve and implement plans for regional development.

(b) That, if the area is to be brought under the control of a regional government, changes in legislation would be required. Certain management controls, such as land acquisition, tax policies, land-use regulation and the use of easements would be brought into effect to implement the recommended land uses.

(c) That the population of the region will reach one million by the year 2000, and the region will be under the influence of an additional five million people in the metropolitan area to the south.

On the basis of these statements of goals and assumptions, the following objectives for future regional development were assumed:

(a) A thorough examination of environmental design should be incorporated into the development plans of the region.

(b) Provision should be made for the sustained participation of the agricultural sector in the economy on lands of community size capable of supporting this use. Zones where agriculture would have priority over other uses should be established.

(c) An adequate distribution pattern of recreational and natural areas for a variety of intensive and extensive uses should be established.

(d) Ecological as well as economic criteria should be used in the development of transportation corridors and urban areas.

(e) Urban sprawl and 'ribbon' development should be avoided wherever possible.

More specific targets and objectives will be examined and discussed in the following sections that deal with recommended land uses.

7.04 Format of the Simcoe Scenarios

The study area, for which a 'Scenario 2000' was prepared in 1968 and 1969 covered an area of about 2100 square miles. Included within this area was all of Simcoe County, with the exception of the extreme southern portion, the north-east one-fifth of Grey County and the north-east one-third of Dufferin County.

The scenarios show the location of five recommended multiple-use economies required to satisfy the needs of the people of the region assumed above, namely:

(a) Multiple-Use Farm Land
(b) Multiple-Use Forest Land
(c) Multiple-Use Recreational Land
(d) Multiple-Use Natural Areas
(e) Multiple-Use Urban Area

The location of the above patterns of multiple use are indicated on the scenarios by hachure and not by a specific symbol. In the scenarios the letters in the symbol for a particular multiple-use area indicate more specifically the major and minor land uses recommended for the area. The type of multiple use can be ascertained from the symbols. For example, multiple-use agricultural areas have one of the following in the initial position: A (for general farming), K (for cash crops) and G (for pasture crops). The order in which the symbols are shown on the scenario indicates the relative importance of the production of each individual land use. Also, an upper case letter indicates a major use, a lower case letter a minor use.

7.1 PLANNING FOR MULTIPLE-USE FARM LANDS

This classification is applied to areas of community size on which food and other plant and animal 'farm' products are (could be, or should be) the major types of production. For the purpose of this appraisal of present, potential and recommended land use, 'farm land' production has been divided into four classes, namely:

Map Symbol	Type of Production
1. A or a	Agriculture (general - based on livestock)
2. K or k	Cash crops (such as tobacco, potatoes, apples, grain if not fed on farm)
3. G or g	Grazing (P or p on the 1969 Scenario)
4. O or o	Open space recreation (includes hobby farms, riding stables, vacation farm, landscape experience)

Local inclusions of natural-area multiple use:

5. T or t	Timber crops
6. W or w	Wildlife crops

7.11 The Needs of the People for Food and Open Space

7.111 Food. The agricultural suitability of lands in the Simcoe Region must be seen in relation to other lands in the Province of Ontario. Very little of the land in the study area has first-rate suitability. However, when it is realized that the total area of first-rate lands in the province is limited and that much of it is being covered with asphalt and subdivisions near the larger cities, lands having suitability ratings 2 and 3 become important. Since Ontario is already a food importing area and Simcoe Region is close to the markets of metropolitan areas, agricultural lands in this area assume major significance.

7.112 Open Space. The rapid increase of population in the Toronto and other metropolitan areas of southern Ontario, with resultant crowding, puts a premium on open space. If the forecasted population growth takes place in Ontario, this need will become even more critical. Though many of the agricultural lands would not be used physically for walking or hiking, they would provide a sense of release for persons simply driving through the area. The growing interest in farm vacations by city people puts a further premium on farm land.

7.12 Selection of Recommended Agricultural Areas

The approach has been to show all areas of high agricultural suitability and to subdivide these into two: (a) those large blocks of agricultural land which should be reserved at all costs; and (b) other areas all or some of which may be found to be needed for agriculture through a provincial survey.[1]

The scenario indicates those areas which have a high suitability rating for multiple-use agriculture, a large proportion of which should remain as open-space providing both food and recreation not only for the residents of the region but also of the whole province.

---

[1]For such a provincial survey, scenarios such as these are required for all of the agricultural areas (c.f. Cochrane Clay Belt Plan for Year 1980, by Hills and Portelance 1960).

The first consideration was that of the comparative potential of the various land units for the production of farm crops. For this the published agricultural capability ratings of A.R.D.A. are of limited value. These ratings apply to the potential of the soil for general agriculture. Specific ratings are required for cash crops such as potatoes, tobacco and orchards and also for pasture crops. Furthermore, the A.R.D.A. ratings are assigned to mapped areas of soil series; those of this report, to a land unit. The land unit approach provides for a distinction to be made in (a) the variation in capability in soil series from one land unit to another, (b) variations due to the down-grading effect of soil series of low potential on the lands of high potential with which they are intimately associated at the farm unit level. This would also hold true at the land unit level were it not that here open space and diversity of landscapes have recreational values which may compensate for lack of homogeneity for food production.

The second consideration is to determine if the present condition of the farm unit is such that the potential of the land can be utilized.

It is commonly assumed that suitability ratings should parallel capability ratings in southern Ontario where there has been a period of farm occupance sufficiently long to sort out the best farm lands. However, this is not the case for three reasons:

(a) Differences exist in the ability of the various ethnic groups to utilize the agricultural resources of the land at different levels of potential. Since some farmers are better than others, farms in a good state of productivity are not necessarily those of high capability and vice-versa. For example, many of the good Mennonite farms of Waterloo County are on land of moderately low agricultural potential.

(b) In the past, a farmer single-handed could not manage satisfactorily much more than one hundred acres of land. This is too small an area under present-day technology and standard of living.

(c) Technology has not sufficiently advanced to show a satisfactory benefit-cost ratio in the clearing, stoning and draining of additional farm land.

In the Simcoe Region, the capability of the land for general agriculture has not been realized due largely to small field size, small farm size and small and/or inefficient farm plant. Therefore, one of the major inputs in this region is to correct these limitations. Thus, in general, the average suitability rating of land units in this region is one class lower than its capability rating. This means that there are no first-rate suitability areas even though there are areas of Capability Class 1. Some land units in the Shelburne area almost merit a first-rate suitability rating. There are a number of farms having first-rate suitability but these are too few and often too widely distributed to be effective in raising the average rating of the land units.

In order to designate lands to be reserved for agriculture for Ontario, it would seem necessary to have some targets for agricultural production or for acreages of lands of the various levels of potential at some specified time. Since such figures are not available for the region it has been necessary to establish an arbitrary level. Should such an appraisal of Ontario be made on this basis, an analysis will show if the level chosen in this study was too high or too low.

On this basis, the areas recommended for agricultural use include all community size areas having a capability rating of Class 3 or higher[1] and a suitability rating of Class 4 and higher. The recommended agricultural areas do not include present and recommended urban and transportation areas.

7.13 Strategic Multiple-Use Agricultural Areas in the Simcoe Region

Land units which are considered by the planning team to be of great importance in meeting the demands of the future populations for food and open space amenities are as shown on the scenarios. Since these are not differentiated on the map from the next category, the following merit specific mention.

7.131 Groups of Land Units with Second-Rate Suitability.

Shelburne Landscape Unit: Land Units Nos. 46-23, 44-26;
thriving potato growing and general farming area.

Beaver Valley Landscape Unit: Land Units Nos. 44-15, 86-5;
most suitable apple land in Ontario; also high suitability for open space amenities; produces 25 percent of total apple production of Ontario.

Alliston Landscape Unit: Land Units Nos. 46-41, 44-21, 44-22;
important for production of potatoes, tobacco and corn; potato production is 30 percent of total Ontario production.

Elmvale Landscape Unit: Land Units Nos. 50-2, 46-8, 4-2, 56-1;
highly productive clay loam area for general farm crops, beef and dairying. Area needed to maintain an open space block in perpetuity as urbanization develops around it rather than within it.

7.132 Groups of Land Units with Third-Rate Suitability.

Stayner Landscape Unit: Land Units Nos. 50-4, 44-16, 4-3, and
Borden Landscape Unit: Land Units Nos. 47-17, 44-18;
highly productive for general farm crops.
These five units are needed to maintain an open space in perpetuity as urban and transportation development takes place around it.

Huronia Landscape Unit: Land Unit No. 46-7;
seed potato production very important owing to isolated position from other farming areas reducing chances of disease spread.

Osprey Landscape Unit: Land Unit No. 46-17;
a valuable open space area. Area for general agriculture and pasture crops.

7.133 Areas of High Suitability for agriculture Vulnerable to Inroads of Urban and Highway Development.

Thornton Landscape Unit: Land Units Nos. 46-20, 46-22, 86-8, 86-7;
Barrie Landscape Unit: Land Units Nos. 46-14, 46-15; and
Collingwood Landscape Unit: Land Unit No. 44-11;
all of these land units have a high potential for agriculture but are

[1] J.R. Carpenter (1962) found the present margin of economic agriculture in Tweed District to be between class 2 and 3.

presently in the pathway of urban sprawl. These areas can be maintained in agriculture if other lands of lower agricultural potential are used for urbanization. This can be done by planning 'before the fact'.

7.2 PLANNING FOR MULTIPLE-USE FOREST LANDS

Forest lands includes all land on which the production of forest and other natural vegetation is or should be the major land use.

In this report the term, 'multiple-use forest land' has been applied to broad areas in the sense of a community economy, therefore it will frequently include areas having a potential for pasture and in some cases tilled crops. For the purpose of this appraisal of present, potential and recommended land use on a community scale, multiple-use forest land is divided into seven main classes as follows:

Map Symbol	Type of Production
1. T or t	Timber production
2. W or w	Wildlife production
3. O or o	Open-space recreation
4. P or p	Grazing land (periodically cultivated or not cultivated)
Local inclusions of:	
5. A or a	General agriculture
6. L or l	Rural residences
7. S or s	Hill-based recreation

Not all multiple-use forest lands have all seven uses. All areas have at least two uses, one of which is usually timber production. If timber production will not constitute the major use on the greater proportion of the area, it is more appropriately classified as a multiple-use natural area as described in Section 7.4.

7.21 Feasibility of Timber Production and Forest-Based Industries in the Simcoe Region

In determining feasibility of using areas as forest land, the wisest use of the land in the region as a whole was considered. The land units which could be most feasibly used as forest lands are those areas with the highest suitability rating for the multiple forest use, excluding areas the feasibility of which is higher for other uses. The calculations presented in Table 8 were made recognizing

Table 8

AVAILABLE TIMBER RESOURCES IN THE SIMCOE REGION
(WITHIN A 60-MILE RADIUS OF WAUBAUSHENE)

	Section 1	Section 2
Distance from Waubaushene	45 miles	45-60 miles
Total Area (acres)	2,858,342	2,725,173
Land Area (acres)	2,614,712	2,567,027
Productive Forest (acres)	1,146,956	1,118,946
Woodland (%)	43.9	43.5
Volume		
Total (M cu.ft.)	1,315,247	1,578,641
4" - 9" (%)	47	49
10"+ (%)	53	51
Poplar (%)	15.9	14.4
Poplar (M cu.ft.)	209,515	226,847
Allowable Cut		
Patented Land (M cu.ft.)	32,420	31,800
Crown Land (M cu.ft.)	5,820	5,620
Total (M cu.ft.)	38,240	37,420
Total (cords)	450,000	440,000
Current Utilization (% of Allowable Cut)	61.4*	61.4*
Annual Surplus (cords)		
Total	174,000	170,000
Poplar 44.7%*	78,000	76,000
Hardwoods 22.7%*	40,000	39,000
Softwoods 32.6%*	56,000	55,000

* Average for the entire region.

that multiple-use forest areas are not planned for 100 percent timber production and that multiple-use agricultural areas have various proportions on which timber production is feasible. For the purposes of this model, Waubaushene was chosen as the centre of the wood manufacturing industry.

In the past few years, as far as hardwood production has been concerned, there has been a general decrease in both quantity of timber harvested, and in quality of this timber. This is largely due to a past history of exploitation, highgrading, poor tending, and in general, poor management practices. At the present, it is felt that the production of softwood timber is in balance, or tending to increase due to a larger proportion of the pine plantations producing merchantable wood.

By planning timber production as a major, or a co-major use in many areas, it is hoped that forestry practices in these areas, and in the region as a whole, may be improved. In this way, it is hoped that the downward trend of hardwood production, both as to quality and quantity, will be reversed. As far as softwoods are concerned, it is hoped that existing softwood plantations will be maintained and tended, to realize the land potential. Where it is economically feasible, marginal or sub-marginal lands presently being used for agriculture should be planted and brought into timber production. Many such areas could produce quality hardwoods after one or two rotations of coniferous crops.

Those areas with a high feasibility rating for timber production and recommended to be used for forest lands should be protected and improved. As forest lands, these areas will produce the greatest benefits to the populace in terms of recreation, wood production, wildlife production, and watershed protection. In this section of the report, the forest industries to be considered are: lumber, pulp and paper, boltwood, particle board and plywood and charcoal.

7.211 Lumber Industry. Sawmill operators complain of the difficulty of obtaining an adequate quantity of sawlogs of suitable quality; therefore, it is not considered feasible to suggest that timber supplies exist to support any new sawmills of efficient size. This is borne out by the decrease in number of profitable sawmills within the region over the past few years.

7.212 Pulp and Paper Industry. If the whole of the Georgian Bay Region, including the Simcoe Region, is considered, it has been estimated that a surplus of over 68 million cubic feet of low quality hardwoods are available on an annual basis. Besides this, a substantial volume of softwoods would also be available. If no more than 25 percent of these surpluses were utilized, one modern pulp mill could be easily supplied on a continuous basis. In determining the feasibility of establishing any forest-based enterprise, however, the market for the products of the enterprise must be considered as well as the wood and water supply. At the present time some expansion of the industry is taking place and from the point of wood availability the Simcoe Region and vicinity could supply the requirements. Expansion in this region however must be gauged against the feasibility of expansion in other regions - presently other regions appear to be more attractive.

7.213 Charcoal Industry. At present, the industrial use of charcoal represents about 50 percent of the market for this product. This use is declining very rapidly. The consumer use of charcoal, mainly for barbecuing, is the other major market. Barbecuing is generally considered to be a fad, and represents a very unstable market for charcoal. Thus, the market conditions for charcoal products are not promising. The predicted consumption of charcoal in the future (1976) is expected to be about 12,000 tons in Ontario. This requires only 24,000 cords of hardwoods (excluding poplar). The hardwood surplus greatly exceeds this figure (Table 8), so the charcoal industry at best would do little to reduce the present surplus. In addition, major charcoal suppliers are already located close to the Simcoe Region (at South River and at Huntsville). Under existing conditions, therefore, expansion of the charcoal industry into the Simcoe Region is not considered feasible at this time.

7.214 Boltwood Industry. At present, the boltwood industry produces material used mainly for wooden pallets and vegetable boxes. Some high-quality dimension stock for the furniture industry is also produced. With an ever-increasing use of corrugated cardboards, it is expected that the demand for wooden vegetable boxes will disappear in the near future.

Although high quality sawlogs are becoming scarcer, much of the surplus hardwood timber found in the region is suitable for high quality small size dimension stock suitable for the furniture industry. Expansion of the industry through greater mechanization and mass production techniques to reduce costs would provide an excellent market for this material. Should such expansion take place, it is not likely that the consumption of hardwoods for this industry would exceed 15,000 cords per year in the foreseeable future. However, the boltwood industry, to produce quality dimension stock for the furniture industry, would be a good prospective industry for the Simcoe Region.

7.215 Particle Board Industry. Particle board has a large market due to its versatility for many uses, such as veneer core stock, construction forms, and almost all the uses of plywood. It may be made from almost any wood, including softwoods, and low density hardwoods. The best species for producing particle board is poplar, of which there is a large surplus within the Simcoe Region. In 1957, an active market began to develop and the consumption has continued to grow.

The prime future markets for this material are the furniture industry and the construction industry in Southern Ontario; it is probable that there will also be a large demand for this product in the United States and Europe.

From past surveys, it has been found that the optimum mill size is one of 24 tons per day capacity. A mill of this size requires only 30 cords of poplar per day; or about 7,500 cords of poplar per year. From Table 8 it is obvious that the surplus of wood supplies within this region could sustain many such mills. Midland, as a deep-water port, and Barrie, strategically located relative to the southern Ontario market, would both appear to be well suited as locations for particle board plants.

7.216 Plywood Industry. Plywood may be produced from either hardwood or softwood. However, the specifications for the logs used in the process are high regardless of the species used. Because of the limited availability of high quality hardwood logs, which is presently limiting the expansion of the sawtimber industry, there seems little likelihood that the hardwood-plywood industry could economically expand in the Simcoe Region.

The softwood-plywood industry has not yet made commercial use of the softwoods from plantations in southern Ontario. However, tests have shown that there are no serious technical limitations to the use of red pine and probably other plantation species for this product. The softwood plantations in the region could provide a substantial proportion of the raw material required for a softwood-plywood plant when the plantations are somewhat older. A consistent program of softwood planting could insure the continuity of such an industry in the region.

7.3 PLANNING FOR OUTDOOR MULTIPLE-USE RECREATIONAL LAND

'Recreation' is the active, pleasurable and constructive use of leisure time. It is the free disposition of time that results in relaxation from physical and emotional stress. 'Leisure time' is that portion of time in which one is not occupied with obtaining the physical necessities of life such as food, clothing and shelter. 'Outdoor recreation' is all resource-based outdoor activities which are carried on during leisure time and which revitalize the body and mind.

In this study 'recreation' means 'outdoor recreation' as defined above.

For the purpose of this appraisal of present, potential and recommended land use, the community-size areas of recreational land have been divided into the eight main classes shown on the scenarios. These are as follows.

1. B or b — Water-based recreation: bathing, boating
2. C or c — Cultural: historical, educational
3. R or r — Ecological reserves
4. O or o — Open-space recreation: natural landscape experience, viewing, hiking cycling, snow-mobiling, motoring
5. S or s — Hill-based sports: skiing, hill or cliff climbing
6. W — Wildlife-based recreation: hunting, fishing, viewing
7. L — Rural residences: cottages, chalets, hobby farms
8. P — Park-based recreation: intensive uses such as camping, picnicking, etc. If use is extensive include under open space.

Although ecological reserves and associated areas provide an educational experience and have a high cultural rating, this land use is included in multiple-use natural areas since a different type of people-management is needed than for other open-space recreation.

7.31 Planning for Wildlife-Based Recreation.

There are few areas on which 'land' management is solely for wildlife production or wildlife-based recreation. Exceptions are areas of waterfowl and other game preserves such as the Tiny Marsh. More of these are needed in Southern Ontario but none is being recommended for the Simcoe Region.

It is on significant proportions of multiple-use natural areas that wildlife management is generally a designated use. Regulation must be strictly enforced to permit hunting and fishing in some parts and to restrict such activities in other parts where the preservation of all wildlife may be a major purpose, *inter alia,* of the establishment of ecological reserves within natural areas.

For convenience of discussion, wildlife species may be grouped into three classes as follows:

(a) Farmland: The wildlife of fields and pastures with treed, scrub and herbal fencerows and groves. Farmland species in the region are Hungarian partridge and European hare, pheasant in warmer climate and sharp-tailed grouse on broader areas.

(b) Woodland: The wildlife of forest openings and edges and of scrublands. Woodland species in the region are deer, ruffed grouse, rabbits, woodcock.

(c) Marshland: The main species are waterfowl, muskrats and beaver.

7.311 Wildlife on Farm Lands.

Areas in which there is an intensive type of agricultural production, particularly with monocultural cash crops such as corn, tobacco and potatoes,provide little opportunity for an integration of agricultural and wildlife production. Efficiency in agricultural production involves 'clean' farming without hedgerows and the development of all land but that which is severely broken by stream courses and rock ridges. However, within those communities designated for multiple-use agriculture there are sizeable blocks of land which will continue to have wooded and pastured areas which are amenable to wildlife production.

Most of the multiple-use agricultural areas designated on the scenarios have a moderate level of suitability for farmland wildlife. There are local areas included in the agricultural lands where the rating for woodland wildlife is also moderate. The capability of most of these lands to produce food and cover for wildlife is very high but the input required to maintain satisfactory conditions under 'clean' farming operations lowers the suitability rating.

Some of the multiple-use agricultural areas are so broken with stony, wet and shallow soil areas that the conditions are more suitable for woodland wildlife than for farmland wildlife. These areas may be located on the maps where grazing (symbol P) is indicated to be a major use; for example, in the Foxmead and Osprey landscapes.

The rich soils of the Elmvale landscape have a high capability of attracting migrant geese with Tiny Marsh and Georgian Bay forming seclusion waters.

It has been estimated that the goose management program on the refuges in southern Illinois are worth about $1,000,000 to the town of Cairo. Lack of money and of provincially-owned lands of suitable capability and of adequate acreage have prevented Ontario from developing an intensive waterfowl management program, except in the Lake St. Lawrence Park where a start has been made. As indicated for Cairo, the local impact of such development may be significant.

The most promising area for development as a goose refuge is in the Tiny Marsh and adjacent portions of Georgian Bay. Dragline operations along the sides of the creek bed would be one method of creating suitable ponds.

The use of corn by the geese can be integrated with a general farm operation. The geese use the grain only and are unable to reach a high proportion of the cobs unless the stalks are knocked down or the corn picked and then fed as needed. It might be possible to pick the corn for feeding and then cut the stalks for silage.

Blinds and pits for hunting can be sited around the peripheries of the refuges and should be located at a density of about one per 25 acres. Experience and the pattern of goose behaviour will indicate where additional blinds can be located and the extent to which certain sections of the refuge boundary may be useful for hunting.

There should be little or no conflict between a goose public hunting ground and predominantly grazing form of land use. Some minor concessions and adjustments may be necessary in the interests of each but they are basically compatible if not complementary uses of the land.

7.312 Wildlife on Forest Lands. Wildlife production can be integrated within the broader areas of forest land, but there are some definite limitations. Wildlife production tends to be concentrated on forest edges and cut-over areas. The latter are not permanent clearings and food production would tend to be sporadic unless large areas are so managed that there is always a good distribution pattern of open and cut-over areas. Plantations are somewhat unsatisfactory for food production having little underbrush and are normally limited to one or two species which reduces the opportunity for diversity. Hardwood woodlots present more opportunity, especially if tending practices and logging procedures are intelligently planned to assist wildlife production.

Areas designated as multiple use forest areas on the scenarios usually have an average level of capability for the production of wildlife food although the rating for production of wildlife cover is quite high. Suitability ratings are below average where the present vegetative cover is inadequate and average where there is a fairly good distribution of natural vegetation such as in parts of the Osprey landscape. However, the suitability of these lands for wildlife will lower as the area under forest increases unless multiple-use management provides the balance between conifer and hardwoods and between mature forest and open space which will be required.

7.313 Wildlife on Multiple-Use Recreational Lands. Recreational lands, except those of intensive use, generally provide excellent conditions for a type of management of wildlife compatible with the other uses. Usually open areas must be maintained in agricultural or pasture crops for open space activities and viewing. Forest cover must be present on planned locations within the landscape and properly managed as well. This interspersion of food and cover is most beneficial.

Trails for skiing will provide suitable access for hunting and viewing. Other facilities, parking lots, buildings, etc., can be effectively utilized by hunters, naturalists and other viewers.

7.32 Capability of the Region for Recreation

The classification of land for outdoor recreation in the Simcoe Region is done within the framework of land units and landscape units as discussed in Section 3.4. Thus the classification of land for recreation and other major uses has a common base. However, the physiographic characteristics (landform, materials, etc.) are usually based on the types of recreation required by today's society and on the present level of technology available for the development and management of these types of recreation.

Each landscape unit or other area considered for recreation in the Simcoe Region was rated for its potential to attract and sustain intensive recreation. Thus, the specific unique attributes as well as all other physiographic, biological, and cultural features of each unit that influence its potential for recreation must be evaluated. There are no units in the Simcoe Region that are classed lower than the fifth rate.

The capability of Wasaga Beach to attract and sustain intensive recreation (bathing) is Class 1. It has a clean, hard, fine, deep sand for both wet and dry beach; very gentle slope on both wet and dry beach; free of obstructions on the beach; an unusually long, uninterrupted bathing area and a westerly aspect. This exceptional bathing area is complemented by desirable camping areas; an historic site of regional significance; a unique area of sand dunes suitable for low density housing in a parklike setting; the Nottawasaga River; Tiny Marsh; and areas for many types of walking or riding. Although many 'value judgments' are involved, the potential for recreation in the Wasaga landscape unit is as good as any other unit in the Simcoe Region.

Land unit 97E-2 of the Blue Mountain landscape unit is rated Capability Class 1, primarily on its potential to provide excellent skiing. The ski hills have over a 700-foot vertical drop, northeast aspect, high (over 80") annual snowfall, a wide variety of slopes and relatively smooth topography on the slope and for the outrun area. The complementary features in this unit include a spectacular view because of the height above the surrounding territory to the north and east; the wide panorama available and the variety of pattern to be viewed - farmsteads, woodlots, large body of water (Georgian Bay), urban area (Collingwood) and several hamlets. Other features include interesting hiking areas, unique rock formations (caves), and potential lodging sites. Most of the escarpment in this area is well wooded. The wooded areas enhance the skiing environment and the openings for the ski runs now developed and to be developed, provide a valuable cultural contrast, adding to the appearance of the escarpment.

There are several units in the Simcoe Region that are essentially agricultural in their character and offer much less in the way of recreational potential than the two units discussed above. The Elmvale landscape unit, typical of many of the flat agricultural areas, offers limited views of the cultural pattern, moderate dry-land game production to attract hunters and viewers, and limited opportunities for outdoor recreational experiences. This unit is rated Capability Class 5 for recreation.

An historical feature of national or provincial significance is given much more value than one of only regional or local significance. Such a unit need have only one additional feature of regional significance to be rated Class 1. A unit with features of local significance only is rated Class 5. An exception to this outline is the Huronia landscape unit. The presence of Martyr's Shrine (probably provincially significant) in this unit would normally mean that the unit needs very little else to be Class 1. However, historic sites of national or provincial significance do not necessarily have the same ability to attract *and sustain* intensive recreation within the unit as do such natural features as Wasaga Beach of the Blue Mountain. The Huronia landscape unit has at least three types of recreational features (bathing, lodging, travelling, etc.) in various parts of the unit that are collectively regionally significant. Thus the unit is rated Capability Class 2 on the basis of these features that will attract and sustain intensive recreation.

7.33 Suitability of Lands in the Region for Recreation

Each unit for which a capability rating is established, as discussed above, must now be considered in the context of both this capability, and the present degree to which this capability has been developed. It should be noted that a unit, or part of a unit, will not 'produce' at its potential even if this potential has been fully developed and managed until it is also used by people to its full capacity.

As an example of the method of determining suitability of a given unit consider land unit 97E-2 of the Blue Mountain landscape unit. Its capability rating is Class 1 but it is not developed to its full potential. To attain the potential of Class 1 the input required would place the unit in Suitability Class 2.

The Elmvale landscape unit is Capability Class 5 and Suitability Class 6 for recreation. This means that the cost involved to raise the level of development of this unit to its capability, which is still only Class 5, is not likely to return the output required for a favourable input-output ratio.

7.34 Recommended Recreational Land Use in the Simcoe Region

The areas in the Simcoe Region for which recreation is recommended as the major or co-major land use are mainly along the Georgian Bay shore and the Niagra Escarpment, including the Beaver Valley. Those parts of the Georgian Bay shore that are within recommended urban areas (see Maps 23 and 24) are not dealt with in these scenarios. Recreational values of these lands should be given due consideration in the development plans for the urban areas concerned.

Recreation will be a major use on many areas other than those mentioned above, on which it may be either a local area of intensive use or a broad area of extensive use. Areas such as the Minesing Swamp, where recreation will also be a major use as part of a natural area is discussed in more detail in Section 7.41. The contributions of wildlife and fish to the recreational potential of all areas is also discussed in the wildlife section.

7.341 Recommendations for Water-Based Recreation.
(a) Wasaga Beach. The most significant portion of the Georgian Bay shore for recreation is Wasaga Beach and the lands associated with it. The excellent sand beaches provide the basis for intensive use for bathing. However, much enlightened development is required in the entire Wasaga area before the full recreational potential can be reached. The present patterns of vehicular traffic, both on the beach and directly behind it, and the usually low quality and low density living accommodation practically on the beach itself are probably the two most significant aspects which attenuate the potential of the beach at the present time.

In the Wasaga area there are excellent opportunities to develop high-quality single-unit high rise hotel accommodation and many of the features that can form the basis for the more extensive types of recreation. The accommodation and other facilities would also be co-ordinated with the excellent skiing facilities on the Blue Mountain, a few miles to the west. The more extensive types of recreation include canoeing and fishing in the Nottawasaga River; hiking, nature study, historic features, and riding trails along the river, in the dunes, and other wooded areas; nature study, bird watching and hunting in Tiny Marsh and winter-based sports such as snowmobile, travelling and snowshoeing. These complement the beach resources and add variety for the many thousands of persons who will take advantage of the facilities provided.

(b) Georgian Bay and Inland Waters. Practically all of the shorelands of Georgian Bay that are not urbanized have a high recreational suitability and are recommended for this use. The intensity of development and use will vary, but bathing and swimming will always be prominent and boating will be more significant in the areas where the water is relatively deep close to shore.

7.342 Recommendations for Land-Based Recreation. The Niagara Escarpment provides the basis for recreation of a very different type from that provided by the Georgian Bay shores. Some of it will be for intensive use, such as skiing. Recreation is recommended as the major use for the remaining portions which can provide a wide variety of open-space recreation and of a high quality that is rarely found elsewhere in Ontario. There are also many unique situations within this escarpment area.

(a) Skiing. Skiing is the major winter sport along the escarpment. The most intensive developments have taken place along the section known as the Blue Mountain. There is also much skiing potential yet to be developed in this area. Other areas with significant downhill skiing potential are on the west side of the Beaver Valley and along the escarpment south of the Blue Mountain. The sharp eastern face of the escarpment south of the Blue Mountain has been largely covered by moraine dumped on or in front of it. However there are still many areas where downhill skiing will be developed and where the potential for cross-country skiing is high.

(b) Open-Space Recreation. The very broken but rolling topography of the part of the escarpment south of the Blue Mountain provides the basis for the more extensive uses such as viewing, hiking, snowmobiling, nature study and many other forms of travel. The use of this area for such purposes will be enhanced by a rather intimate pattern of wooded land and open land, with some interspersion of

man-made features such as roads, small towns, and farm buildings. Forest land will occupy a large proportion of the area and with proper management will provide a significant volume of timber while fulfilling its prime function of providing much needed amenities for recreation. Some land will be managed mainly for pasture and certain areas are of such a nature that viable farm units based on field crops can be maintained.

There are parts of the Blue Mountain and Hockley Valley landscape units that will provide the setting for a very exclusive type of home. There is currently a significant number of old farmsteads being renovated and used as large country estates. In addition to this, there will be numerous areas developed where exclusive housing will be built in small clusters in an aesthetically pleasing setting. These clusters will be serviced from common facilities and be secluded from large sprawling, monolithic subdivisions. They will also require reasonable access to shopping facilities and to an efficient transportation system to urban areas. The numerous cool streams, the small ponds that can be developed from the springs, and the upland wildlife also add much to the recreational value of these escarpment landscapes.

(c) Ownership Patterns. The present ownership pattern of most of the escarpment area is such that a decreasing amount of it is available for use by the public for recreational pursuits that involve travelling over the land. However, as the pressures for use become greater, provisions for public travel across private land will be made through various arrangements such as easements[1].

7.343 Recommendations for Multiple-Use Forest Lands. All multiple-use forest land will be used for the open space type of recreation recommended above for the escarpment landscape units. The production of timber or pasture will usually be as significant as the recreational uses. An exception to this is an area in the Horseshoe Valley landscape unit that is being developed for skiing and other winter sports. In this area, recreation is the dominant major use.

7.4 PLANNING FOR MULTIPLE-USE NATURAL AREAS

Natural areas are non-farm non-urban areas supporting forest, marsh and other wildland vegetation.

Multiple use is the use of an area for two or more major uses under a single management program.

A natural area is a pattern of biotic ecosystems, i.e., production systems comprised of communities of plants and animals and their non-living environment. Strictly speaking, a natural area should be restricted to natural ecosystems which are not used by man. A limited acreage of such areas is essential in order that a supply of plant and animal genes are available to maintain the natural environment of the entire area. In this way, non-use is one of the

[1]The Niagara Escarpment Study Group (1968) have recommended that considerable areas be placed under easement and other types of governmental control. It is anticipated that one or more branches of government will acquire some of the more significant nuclear features such as waterfalls and spectacular viewpoints and will manage these for recreational purposes.

multiple uses. However, 'multiple-use natural area' implies that on a large proportion of the area there will be a modified natural environment controlled by ecological management. Thus multiple-use natural area is a pattern of biotic ecosystems which range from truly natural systems, unmodified by man (as far as possible), to those which are slightly modified to provide man with a variety of sensory experiences in a 'natural environment'.

Thus, natural areas as a whole are not non-use areas but ones which are managed to serve a pattern of specific purposes, the main one of which involves a non-direct use, namely, that of the ecological reserves.

The pattern of uses varies from one natural area to another. Those shown on the scenario prepared in 1968 include two or more of the following:

(a) Ecological Reserves.
Plant and animal gene pool to supply material for other parts of natural areas and from hence materials for research.

(b) Open-space Recreation.
Includes (i) natural environment experience: seeing, hearing, smelling, learning; (ii) overland travelling: hiking, cycling, motoring, skiing, snowmobiling, etc.; (iii) hunting and fishing; (iv) collecting of trophies, etc.

(c) Forest marsh and other wildland vegetation for soil and water conservation.

(d) Protection of unique landform features.

(e) Educational experience: outdoor museums.

The proposal to place all natural areas under one management (hopefully a regional government with full decision-making and implementation powers) is made to ensure that weight would be given to each use according to its importance.

The most strategic is that of the ecological reserve which should be protected to maintain a source of gene supply. This is necessary to maintain the natural landscape of surrounding areas and to provide materials (e.g., micro-organisms) for many uses not all of which are now known. For legislation for the protection of ecological reserves, see State of Indiana (1967).

7.41 Land for Ecological Reserves

The goal in establishing ecological reserves is to preserve a permanent reserve (pool) of the genes of the total flora and fauna of the region. To do this it is necessary to acquire the range of physiographic environment in which a range of natural biotic communities can develop under the full range of vegetation successions possible with a minimum of human disturbance.

As the least disturbed portion of natural areas, ecological reserves ideally should be zoned as follows:

(a) A central core in which the natural communities should not be disturbed by manager, scientist or public.

(b) A middle zone in which there is a minimum of disturbance by either manager or scientist and no disturbance by the public.

(c) An outer zone which is transition between the ecological reserve proper and the areas used by the public as outdoor museums and low density natural parks.

There are two reasons for including ecological reserves within a much larger unit dedicated to natural-area multiple use. (i) To facilitate the natural migration of genes from the central protected core to potential areas where there is controlled access given to the public. (ii) To provide the protection required without undue publicity of the location of unique phenomena such as rare species in danger of extinction.

To avoid desecration, the exact locations of ecological reserves should not be shown on the publicized land-use maps. These should be shown on a back-office plan of all the various uses within each natural area. This will help to eliminate conflict of uses on an identical area; for example, public hunting and waterfowl reserves.

There are two main classes of vegetation and fauna which are considered in establishing ecological reserves.

Regional representatives.
Unique species.

These classes are not mutually exclusive.

Outline of the Characteristics of the Most Outstanding Natural Areas.

(a) The Minesing Swampland. The chief potential of this multiple-use natural area lies in a strategic core of ecological reserve. Here are found rare orchids and other fern plants which are representative of the muck areas of the region which are rapidly disappearing as these areas are being developed for agricultural and other uses.

(b) The Kolopore Limestone Plains[1] The chief potential of this multiple-use natural area is centred in the opportunity to preserve the plant and animal communities which develop on a pattern of dry, shallow limestone soils and a type of swamp known as alva which is relatively dry during the summer season.

(c) Limestone Escarpment and Valley Lands. These include the Pretty River, Maple and Hockley Valleys. The chief potential of these multiple-use natural areas are focused on two kinds of areas:
(i) A number of escarpment bluffs (with local caves) with rare species surviving because competition has not eliminated them as it has elsewhere, or
(ii) A number of stream valley sites with rich cold water flowing from the bedrock and from the moraines which cover the face of the escarpment at many points. These valleys have a unique scenic value in addition to a rich flora and fauna.

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[1]This area has been recommended for acquisition by the Niagara Escarpment Study Group (1968).

7.5 PLANNING FOR URBANIZATION AND TRANSPORTATION

Transportation and urbanization are considered together because transportation services are powerful instruments in designing and implementing proposed regional and urban plans.

The Simcoe Region lies on the periphery of the Grand Trunk Transportation Corridor which stretches from Chicago to Montreal. Spurrs from this main corridor are developing largely under the influence of the Great Lakes. The wide range and accessibility of markets, employment and cultural opportunities seem likely to continue to attract an increasing share of new development. The MTARTS directorate (1967) has concluded that the increasing scale and rate of urban growth establishes the need for coordinating regional services and activities. Without a regional government to coordinate the presently divided authority of local and senior government roles, and to develop a plan to guide both public and private development, a pattern of urban sprawl and ribbon development could be expected to proliferate in the Simcoe Region.

On the assumption that the population in the Simcoe Region would reach 1,000,000 by the year 2000 it was decided that some attempt should be made to encourage the following population distributions: Barrie 400,000, Orillia 200,000, Midland 200,000, Collingwood 100,000, and 100,000 throughout the rest of the region as smaller town and rural residents. If these existing centres of population are to be expanded to accommodate the population of 1,000,000 then a network of expressways connecting the four centres (Barrie, Orillia, Midland and Collingwood) to each other and to the metropolitan centres to the south would be required. However, highways and expressways should not be thought of as the only means of meeting future transportation requirements. Public mass transit systems between urban centers cannot be ignored in future proposals for an integrated urban-rural transportation network in the region.

At present there is only one major expressway (Highway 400) in the Simcoe Region. This expressway links the Barrie area with Toronto. A mass transit system and a regional airport to service the proposed new urban developments do not exist.

To satisfy the assumed goals of providing an improved environment, the selection of new transportation corridors will have to recognize the recreational, aesthetic, agricultural and educational resource values that exist in the Simcoe Region. The transportation corridor selection process has, to date, failed in many instances to recognize important social and aesthetic values. Wallace *et al* points out that the objective of an improved method of highway location should be to incorporate social values, resource values and aesthetic values in addition to the normal criteria of physiographic, traffic and engineering considerations.

Existing agricultural, recreational and aesthetic values can be protected or avoided through the planned positioning of interchanges and access points along the main transportation and activity cores. For example, the four-lane highway shown on the scenarios from Barrie to Wasaga Beach and Collingwood should have

controlled access to avoid interference with agriculture and forestry-based activities in the area (Lewis, 1969).

If a new four-lane highway were to be constructed between Toronto and Collingwood it would seem, at first glance, that an area of flat terrain with few construction problems runs through the Alliston area. An examination of the landscape units and existing values, however, shows that this area has a high potential for agriculture. Therefore, it is proposed that the highway be so located that it would serve both the recreational traffic to the escarpment area and the Blue Mountains at Collingwood, and the concentration of population at Collingwood itself.

At the "inter-city" level it would appear that the best expressway corridor between Collingwood and Midland would be via the Wasaga Beach landscape, provided the highway is located south and east of the beach and the planned development.

The structure and design within the boundaries of the proposed urban areas (Collingwood, Midland, Orillia and Barrie) cannot be reviewed in detail in this general overview of the region. However, through such physical design as cluster development and through new concepts in industrialized housing units, provision can be made for a given population, while retaining a large proportion of open space both within and around the urban centers.

To avoid 'urban sprawl' the boundaries of urban areas should be established. A policy that permits urban sprawl leaves few open spaces in its path and it endangers established agricultural enterprises. A monotonous, helter-skelter pattern lacking in visual quality is the common manifestation of such a policy. In addition, urban sprawl can affect the social structure of the community by increasing the distances that people must travel to work and to shop. The process of urban sprawl has been described to a U.S. Congressional Committee as one in which "non-communities are born - formless, without order, beauty or reason - with no visible respect for people or the land."

The President's Council on Recreation and Natural Beauty (1968) suggests that an open space system for a metropolitan area should be selected and reserved in advance of development on the basis of an ecological inventory. Also, if a sound base of ecological knowledge is established for the development of an urbanizing area, the chances of blundering into environmental conflicts should be reduced. Examples of such conflicts include unstable building foundations on unsuitable soils, flooding of developed areas and high costs of placement and design of utilities due to unfavourable soil conditions.

A summary of some of the features that such an ecological inventory should take into consideration are:

(a) the potential water supplies, both surface and ground water in the area;
(b) the major physiographic, topographic, landform and waterform patterns as they affect access, layout of proposed developments, design of structures, location of utilities and sewage treatment facilities;

(c) the structure, composition and depth of the surface materials and their effects on surface runoff and groundwater, and the changes that might occur due to urbanization;
(d) the macro- and micro-climatic patterns common in the area, and their role in the location and design of the urban environment including the control of air pollution; and
(e) the natural, historic and cultural features that may be unique to the region.

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